DOCUMENT RESUME

ED 433 659 EC 307 404

AUTHOR	Hartman, Melissa E., Ed.
TITLE	Imagine...Opportunities and Resources for Academically Talented Youth, 1997-1998.
INSTITUTION	Johns Hopkins Univ., Baltimore, MD. Center for Talented Youth.
ISSN	ISSN-1071-605X
PUB DATE	1997-00-00
NOTE	162p.
AVAILABLE FROM	Journals Publishing Division, The Johns Hopkins University Press, 2715 North Charles Street, Baltimore, MD 21218-4319; Tel: 800-548-1784 (Toll Free); Tel: 410-516-6945; Fax: 410-516-6968; ($30 per year, $5 back issues).
PUB TYPE	Collected Works - Serials (022)
JOURNAL CIT	Imagine; v5 n1-5 Sep 1997-Jun 1998
EDRS PRICE	EDRS Price MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS	*Academically Gifted; *Biology; *Communications; Higher Education; Linguistics; Literature; Mass Media; *Mathematics; Medicine; Multimedia Materials; *Politics; Secondary Education; Talent

ABSTRACT

This document consists of the five consecutive issues of the journal "Imagine..." published during volume year 5. Typical journal articles cover teaching academically talented secondary students in the following focus areas: (1) biological science and medicine; (2) literature, language, and linguistics; (3) public service and politics; (4) mathematical pursuits; and (5) multimedia communications. Many articles were written by students. In addition to articles, each issue includes special program announcements, competitions, book reviews, and puzzles. Sample articles include: "At Work in the Fields" (Hsiuchen Chen, Eric Lai, Lauren Ancel, Cecil Huang, Glina Gounder, Lara Crawford); "Moving into the Workplace: Internship and Volunteer Experiences" (Vandana Madhavan, Carrie Shil Yansky, Darin Sujjavanich); "So You're Thinking about Medical School" (Melissa Hartman); "Rescuing the Reefs" (Eileen Piak); "The True Sense of a Word" (Melissa Hartman); "The Intricacies of Translation and the Creative Role of the Translator" (Lesley Mackay); "From the Inside Out: How To Read a Poem" (Melissa Hartman); "A Notebook of Questions: A Summer Inquiry into Literature and Language" (Katy Wischow); "On Linguistics, Patterns, and Passing French" (Brian Michalowski); "A Life of Politics, A Life of Service" (Erica Gum); "A Passion for Politics" (Dror Yuravlivker); "Two Months at the State House: My Experience as a Page" (Becky Ray); "Becoming a Consummate Debater: Interview with Rebecca Justice" (Eileen Ptak); "Project Rescue Vision" (Cory Snyder); "Economics: Applying Math to Real-World Problems" (Susan Athey); "Exploring Moduli Spaces" (Jordan Ellenberg); "Math Outside the Classroom" (Wei Ho); "Parting the Waters: The Rigors and Rewards of Crew" (Eric Clopper); "Art and Craft" (Cassidy Curtis); "Out of the Living Room, into the Control Room" (Melissa Hartman); "Education at a Distance"; and "Still Life with Movement: Video as Art" (Ted Winstead). (DB)

ED 433 659

IMAGINE

OPPORTUNITIES & RESOURCES FOR ACADEMICALLY TALENTED YOUTH

VOLUME 5

NUMBERS 1-5

SEP/OCT 1997 – MAY/JUNE 1998

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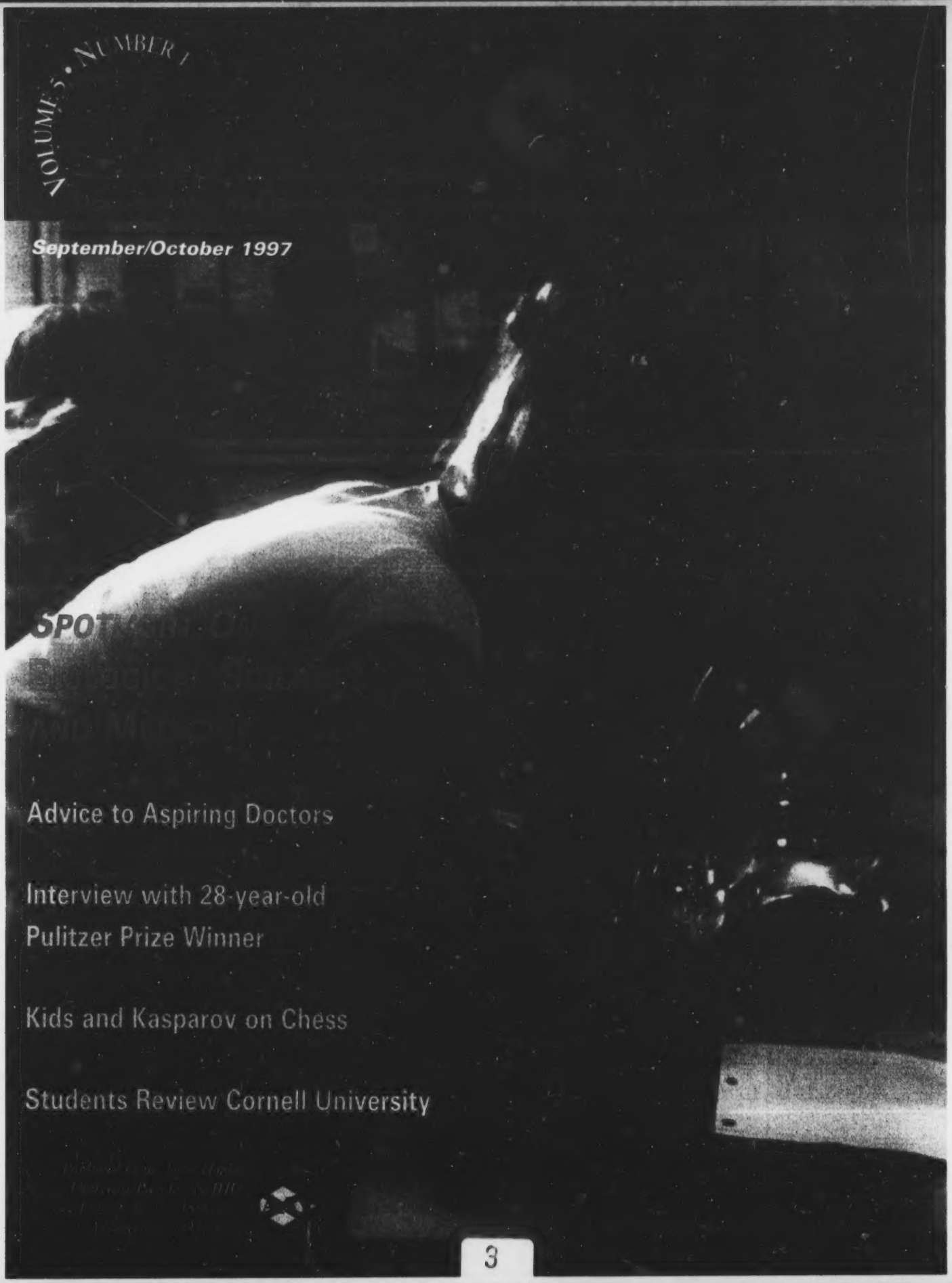
VOLUME 5 • NUMBER 1

September/October 1997



SPOT

Advice to Aspiring Doctors

Interview with 28-year-old
Pulitzer Prize Winner

Kids and Kasparov on Chess

Students Review Cornell University

From the Editor

Dear Reader,

When I assumed the editorship of *Imagine* four months ago, I spent many hours reading back issues. I witnessed the tremendous growth of this publication over a very short time: what began as a 12-page newsletter grew quickly to 16 and then 20 pages. By its third year, *Imagine* was 24 pages long and much more than a newsletter.

As the number of pages has increased, so has the publication's scope. By expanding *Imagine*, we have enhanced our ability to meet the goal set by its founders in the first issue: "to provide the tools students need to enable them to take responsibility for their own learning, reach for academic excellence, and achieve to the full extent of their individual capabilities." Now at 32 pages, *Imagine* continues to include diverse staff- and student-written articles as well as eight regular features, including Creative Minds Imagine, puzzles, Exploring Career Options, and college reviews. The result is a publication rich in voices, varied in perspective, and extensive in coverage.

In this issue we focus on Biological Sciences and Medicine. These two areas have made rapid advances in recent years, dramatically improving our understanding of life—from our own bodies to entire ecosystems—and changing the way we think and live. Our focus articles include insights from people who are exploring our living world in diverse ways: graduate students in fields such as bioinformatics and biophysics, the Baltimore Zoo's curator of birds, medical students, and the Associate Dean for Research of the School of Arts and Sciences at Johns Hopkins University. And to show you how to get started now, students who have had valuable intern and volunteer experiences share some of what they've learned outside the classroom.

To round out the issue, the winner of the 1996 Pulitzer Prize for Feature Writing discusses her career—and the internships, summer programs, and persistence that led to it. Another writer, a college freshman, relates her writing process to Schrödinger's famous thought experiment, and a young chess champion explains the importance of strategy in chess and the game's relationship to math. This range of voices, perspectives, and coverage will continue in upcoming issues with contributions from diverse writers both within and beyond the focus topics.

I'm excited to be a part of *Imagine* as it enters a new stage of development. By building on the solid work of the last four years, I and the entire staff hope to make *Imagine* better than ever. This issue marks a step in that direction.

Melissa Hartman

Want to subscribe to *Imagine*? Call (410) 516-7900 or (800) 548-1784 and ask about our introductory price.

Imagine...
*Opportunities and Resources for Academically Talented Youth**

ISSN 1071-605X
Volume 5 • Number 1
September/October 1997

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Published five times a year—September/October, November/December, January/February, March/April, and May/June.

Application to mail at Periodicals Postage Rates is approved at Baltimore, MD, and additional mailing offices.

POSTMASTER: Send address changes to *Imagine*, The Johns Hopkins University Press, Journals Publishing Division, P.O. Box 19966, Baltimore, MD 21211

Imagine is published by the Johns Hopkins University Press for the Study of Exceptional Talent (SET) at the Johns Hopkins Institute for the Academic Advancement of Youth (IAAY). This publication is an outgrowth of newsletters and programs that, for twenty-five years, have served highly talented students identified by the Study of Mathematically Precocious Youth (SMPY) and by SET.

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Annual subscription: $30.00

Address subscription inquiries to:
Journals Publishing Division
The Johns Hopkins University Press
2715 North Charles Street
Baltimore, Maryland 21218-4319
(410) 516-6989 • fax: (410) 516-6968
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Cover photo by Eileen Ptak

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CONTENTS

Focus On: Biological Science & Medicine

At Work in the Fields
Six graduate students discuss their diverse studies in biology, from biophysics to epidemiology 4

Internships: The Ticket to Your Future
Whether you've decided on a career or just want to explore, an internship can help you clarify your interests and goals 8

Moving into the Workplace: Internship and Volunteer Experiences
What are the benefits of exploring the work world now? Three students share what they've discovered 9

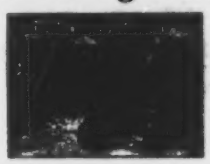
So You're Thinking About Medical School...
Interview with David Trabilsy, Assistant Dean for Admissions at The Johns Hopkins School of Medicine 12

Lessons Learned from ER
Success in medical school requires more than just academic preparation. Some young residents suggest ways to ready yourself for life as a medical student 13

Postcards from Summer Programs in Biology
Summer programs in paleobiology and marine ecology gave these students a taste of what a biologist's life involves . . . 14

Caring for Birds in Zoos and in the Wild
The Baltimore Zoo's curator of birds is working to ensure a future for the African penguin and other threatened species, both in the zoo and beyond 16

Rescuing the Reefs



Coral reefs are often called "the rainforests of the sea." Are they suffering the same fate as their counterparts on land? 18

Strategizing for Fun and Learning

Benjamin Franklin wrote that chess teaches foresight, vigilance, and caution. At competitions and in classrooms, increasing numbers of chess players are putting these skills into practice . . . 20

Exploring Career Options
Interview with Lisa Pollak, winner of the 1996 Pulitzer Prize for News Feature Writing 22

Fascinating Classics
The Once and Future King, *T.H. White's version of the Arthurian legend* 24

Students Review Cornell University . . . 26

Planning Ahead for College
Is medical school in your future? Consider combined college/medical school programs 28

The Coach's Corner 29

Creative Minds Imagine
Schrödinger's Pen *by Yoon Ha Lee* 30

Mark Your Calendar 31

Crossos Games
A biology-inspired puzzle by Tim Boester 32

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At Work In

Whether you are looking for a window on the world or a lifetime career, biology is one of the richest and most promising domains of human study and endeavor. Due to stunning technological advances in computer science and molecular biology, researchers are able to ask and answer increasingly complex questions about the nature of life and the many shapes life takes.

Biology invites all explorers into the full sweep of time, from the prehistoric past to the future. Biological truths are written both large and small: life can be studied in domains that range from the universal to the atomic.

In "At Work in the Fields," six graduate students discuss their budding careers as biological researchers. In brief essays, they tell of the creativity and persistence their work requires and of the discoveries they have begun to make.

Watching, wondering, and formulating pathways of inquiry, the young investigators detect nuances in the workings of life—in strands of DNA, on the bristles of fruit flies, or in patterns of resistance to HIV infection. In many cases, their findings lead to innovation, to the development of applications that can advance practice in areas such as genetics, medicine, or public health.

Sometimes you have to create something artificial in order to learn how the real thing works. One writer is designing a control system for a "simulated human" that—or is it who?—will learn to perform complex platform dives. And *somebody* has to figure out how to stay on top of the massive amounts of information already generated in fields like biomedicine. As another writer explains, that's why there's bioinformatics, the interdisciplinary field in which people design information management systems for the world's store of biomedical data.

All these fields are rapidly advancing. And all are so exciting that working in them sounds like playing in the best sense.

Genetics

by Hsiuchen Chen

Ever since I can remember, I have wanted to learn—learn about things, people, events, and, mostly, the "whys" behind them. Research in biology makes use of this kind of intellectual curiosity and presents the possibility of being the first person, ever, to learn a certain fact. For that reason, I cannot think of any career more exciting than that of biological research.

The results of this research permeate our daily lives, raising critical questions that must be answered by both scientists and society. Genetics predicts medical diagnoses, influences the way we solve crimes, alters the food we eat, and perhaps most importantly, challenges our definitions of self. Finding the genes responsible for diseases such as cystic fibrosis and sickle-cell anemia has not only provided tests to determine whether a person will develop those diseases, but has also yielded insight into the causes of the diseases, thus suggesting new therapies. DNA analysis has replaced fingerprinting as the definitive way of identifying criminals. Genetically modified fruits and vegetables occupy an increasingly large space on grocery shelves. Finally, the recent cloning of a sheep has initiated a maelstrom of debate over the possibility of cloning humans. Implicit in this discussion are questions about what makes one person different from another, and whether the value of human life diminishes simply because a genetically identical life can be created.

In our lab, we attempt to find genes involved in cancer, a disease that has multiple genetic origins as well as environmental influences. My work may lead to better treatments or prevention methods for prostate cancer, or it may simply tell us more about the genes active in the prostate. Regardless of my project's outcome, I will always be learning, and that is what makes research fun for me. ■

Reading, dancing, and playing Chinese chess help ***Hsiuchen Chen*** *to maintain her sanity while she pursues her doctorate in genetics at Harvard Medical School.*

Developmental Biology

by Eric Lai

Multicellular organisms begin life as a single cell. Miraculously, that cell gives rise to a self-organizing collection of cells that eventually becomes a recognizable and functional adult life form, like a tree or a fish. Developmental biologists seek to understand how this incredibly complex process occurs by asking two fundamental questions. First, how do cells differentiate? How is it possible that an individual cell can produce cells as diverse as muscle, nerve, and skin cells? Second, how are patterns generated? How do a butterfly's wingspots or the arrangement of our fingers and toes come about? The processes of creating different cell types and patterning those cells into coherent structures are at the heart of developmental biology.

Our laboratory studies these questions using the peripheral nervous system (PNS) of the fruit fly as a model. The fly PNS is basically an array of mechanosensory organs, which are visible as external bristles. Since each sensory organ is composed of four different cell types, and these bristles are arranged in a precise array, the fruit fly offers us an opportunity to study mechanisms of cell differentiation and pattern formation.

Researchers have identified many genes involved in PNS development essentially by

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THE FIELDS

screening lots of flies for PNS defects. For example, mutant flies with missing bristles, extra bristles, or malformed sensory organs have been isolated. Recently, many of the genes responsible for these mutants have been identified. Several of those genes encode proteins that bind DNA and function as gene regulators. Other key proteins in this process are involved in cell-to-cell communication, indicating that individual cells must "talk" to each other in order to organize themselves into global patterns.

Our work on these tiny insects has broad implications. Organisms as diverse as flies, frogs, and humans all utilize similar strategies and mechanisms to generate cell diversity and patterns. Thus, the lessons that we learn are fundamental principles of how life becomes organized. As a scientist, I am driven by the chance to make my own contribution to our understanding of life. But it is really the inherent beauty of these biological patterns that fascinates me and keeps me interested. ■

Eric Lai is a fourth-year graduate student in biology at UC San Diego. When he's not pushing flies in the lab, he sings and plays guitar in his band, Gesso.

Evolutionary Biology

by Lauren Ancel

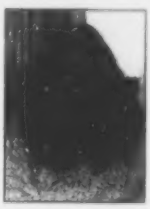
Imagine finding an ancient manuscript on which the secrets of life are written. For evolutionary biologists, DNA sequences are such manuscripts. Evolutionary biology is the study of the processes by which life is created and changes form over time. By viewing DNA through the lenses of evolution, we begin to solve puzzles of great importance to human welfare and to our understanding of nature.

For example, DNA data allow us to infer the migrational history of human beings and even to identify the most recent common ancestors of every person alive today. These ancestors are named Mitochondrial Eve and Y-Chromosome Adam after the cellular entities that enable evolutionary biologists to determine the time and location in which they lived.

Evolutionary biologists also use genetic data to study the interaction between disease and immunological defense. A group of Ugandan prostitutes repeatedly exposed to the HIV virus have not tested HIV positive. This remarkable resistance has been linked to a specific unusual gene within their immune system. Understanding the evolution of such genes may prove critical in our fight against AIDS.

Evolutionary biologists have also found clues in DNA to the relationship between genetic predetermination and social environment. Oyster catchers are a species of bird known to hunt either by piercing the hinge muscle of oysters found under water so that they spring open, or by prying open oysters found on land. Each bird feeds using only one of these two methods, following the lead of its parents. Furthermore, oyster catchers tend to choose mates that perform the same catching routine. Evolutionary biologists seek to determine whether this behavior is transmitted culturally from generation to generation, inherited genetically, or both.

Understanding the complex forces responsible for today's living diversity requires not only abundant field observation and laboratory experimentation, but also sophisticated mathematical modeling. Through a theoretical approach to evolutionary biology, I am able to apply my mathematical interests in complex dynamical systems, probability, statistics, and logic to problems like these that are both intellectually challenging and relevant to the human condition. ■



Lauren Ancel earned her bachelor's degree in mathematics and philosophy, and is now working on her Ph.D. in evolutionary biology. She spends her free time rafting and kayaking.

Bioinformatics

by Cecil Huang

Every day, health-care professionals are deluged with information about diseases, diagnoses, and treatments. Medical informatics focuses on finding ways to use computers to manage all of this information. The goal is to provide doctors better access to relevant medical data, enabling them to make better decisions in less time.

I found out about medical informatics through my premedical advisor when I was a junior at Carnegie Mellon, majoring in Electrical and Computer Engineering and harboring thoughts about M.D.-Ph.D. work; I wanted to be a physician, but I also wanted to continue my technical training. Outside of medicine, I was most interested in math and computer science, so the more I learned about medical informatics, the more excited I became. Here was a field in which I could potentially combine my interests in medicine and computer science, in which I could help build a bridge between these two areas.

The field of medical informatics got its start in the 1970s, when researchers began developing expert systems that provided medical diagnostic advice. Since then, spurred by the need to control health-care spending, the availability of faster computers, and the ever-increasing connectivity of the Internet, medical informatics has

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At Work In

expanded dramatically. Current challenges range from developing standardized electronic medical records to improving methods for mapping and sequencing the human genome.

These challenges must be addressed by professionals who command both an understanding of problems in biomedicine and a working knowledge of computer science and systems. Currently, the typical physician or biomedical scientist has little or no formal training in computer science. On the other hand, many otherwise qualified computer scientists do not appreciate the complexities and subtleties of biomedical data. Medical informatics specialists are therefore needed to bridge the gap between biomedicine and computer science.

In a time when medicine is shifting toward managed care, research budgets are shrinking, and traditional computer professionals are struggling to stay relevant, these "cross-trained" individuals are gaining a competitive advantage both in academia and in industry. With current trends in both the health-care industry and the computer industry, the demand for medical informatics professionals will likely continue well into the next century. ■

Cecil Huang is an MD-PhD candidate in the Medical Scientist Training Program at Stanford Medical School. He hopes to complete his PhD in medical informatics this year and his MD in the year 2000.

Epidemiology
by Celine Gounder

Health is a product of socioeconomic, environmental, and political conditions, as well as a host of other factors. While clinical treatment may improve the health of an individual, it cannot address all of the factors that affect health within an entire population.

Meeting the needs of populations, public health is the practice of medicine at a macro-level. It is an interdisciplinary field that includes such concentrations as epidemiology, international health, maternal and child health, biostatistics, health care management, and population dynamics. My specific interest is in epidemiology, the study of the occurrence and transmission of disease in human and other animal populations.

I became interested in epidemiology and public health in the summer following my sophomore year at Princeton, when I interned for an obstetrician/gynecologist at Columbia Presbyterian in New York City who specialized in high-risk pregnancies. During this internship, I observed the inequities faced by many of the hospital's patients, a large percentage of whom lived in Washington Heights, one of New York City's most underprivileged neighborhoods. It became evident to me that medical treatment alone was not enough to address their health problems, that their health could be improved only by an interdisciplinary approach.

The following summer, I began to study the various components necessary to effect change in the health of populations. I interned at the World Health Organization with Dr. Roy Widdus, Coordinator of the Children's Vaccine Initiative. This program advocates new vaccine development and sets up collaborative efforts between WHO and vaccine manufacturers to produce the most needed vaccines. My work involved studying how political support and funding had been garnered in support of polio eradication and how people were mobilized to carry out the necessary field activities. I then applied this information in investigating possible strategies for measles eradication.

Next year, I will continue to explore public health issues by working for a nonprofit organization called Princeton Project '55. As a project manager, I will work with a core group of five members of Princeton's Class of '55, including Ralph Nader and Gordon Douglas, President of Merck Vaccines, to encourage widespread support for an international program for effective tuberculosis control. A major component of our work will be lobbying Congress for funding for tuberculosis control programs abroad.

I am intrigued by the possibility of effecting constructive change on such a large scale. My graduate work will focus on international health and infectious diseases, after which I plan to go to medical school. By combining medicine and public health, I look forward to even more opportunities to improve the quality of life for both individuals and entire populations. ■

Following her fellowship with Project '55, Celine Gounder will enter a graduate program in epidemiology at The Johns Hopkins University School of Hygiene and Public Health.

Biophysics
by Lara Crawford

"Biophysics" means different things to different people. It can include such diverse pursuits as trying to understand how the wind-sensing organs of a cricket work, investigating the properties of ion channels in cell membranes, exploring the mechanics of blood flow, using magnetic imaging to understand the structure of DNA or proteins, and creating a computer model of a cockroach running. These projects all lie at the intersection between the physical and biological sciences. Interdisciplinary work like this is especially exciting because people

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in different fields have different ways of looking at a problem—the fun is to synthesize insights from both fields into a new understanding.

I came to my current research project in a roundabout way. In high school, I was interested in both biology and physics. I attended Harvard and studied physics with a biophysics emphasis. As an undergraduate, and then as a beginning Ph.D. student, I sampled research in a variety of areas of physics, biology, and engineering. One of these research projects, on human interfaces for remote robotic surgery, turned into an M.S. in electrical engineering science.

My Ph.D. work involves elements of several fields. I'm designing a control system for a simulated human that will learn how to do somersaulting, twisting platform dives (like those performed in the Olympics). The ability to control a complex system like this can be useful in robotics, computer animation, and the development of virtual environments. The control design also has theoretical relevance in engineering.

The diving problem is a difficult one. Because the physics of diving is complicated and there are many joints to coordinate, traditional engineering methods don't provide very good solutions. By tying together ideas from biomotor control (how biological organisms use their nervous systems to control movement), artificial intelligence, and robotic control, however, I hope to get my simulated human to learn to dive. ■

Lara Crawford's research interests include biological and robotic motor control, machine learning and computer animation. She is working on her Ph.D. in bioengineering at UC Berkeley.

FOR FURTHER READING

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For a sampling of biology related Web sites, see http://jhunix.hcf.jhu.edu/~setmentr/links_51.html

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The Ticket to Your Future

Are you fairly certain of your career path? If so, an internship can help you clarify your goals, develop your skills, obtain your first professional credentials, and gain invaluable insights and contacts. Are you uncertain about the future, but ready to investigate some career possibilities? If so, an internship can open the door to an intriguing working environment, giving you structure, guidance, and resources as you explore new territory. Whether your primary interest is advancing your long-term plans or finding something worthwhile to do this semester or next summer, an internship can be just the ticket.

Internships have helped thousands of students leap over the daunting divide between school and professional life; an excellent internship experience can even launch a career. While internships do vary, a good one can teach you a great deal about a field—its activities, standards, required skills, and prospects for the future—and also about yourself.

You are the key to making an internship work for you. The difference between a sizzling and a so-so experience can boil down to how proactive you are in selecting and shaping your internship and how persistent you are in making the most of it.

Of course, you will not be able to control all the variables. You are unlikely to be able to transform a highly structured internship into a free-form one, create a strong professional relationship with a mentor when no one is available to play that role, or take your work in a direction that does not serve the interests of the organization that gave you this opportunity. That's why it's important to select your internship carefully.

In evaluating possibilities, try to be both demanding and realistic. In general, focus on those opportunities that will provide you the most access to substantive tasks that will allow you to develop your abilities. Keep in mind, though, that interns are often asked to do a fair amount of busywork—the administrative tasks that allow any organization to function. Don't be hasty in ruling out an internship that will involve some mundane tasks. Consider the benefits inherent in the prestige of the institution, the knowledge you will absorb just by being there, and the support you may gain by performing a wide range of tasks in an enthusiastic, professional manner.

A good internship can teach you a great deal about a field—its activities, standards, required skills, and prospects for the future—and also about yourself.

As internships vary, so do the strategies you can use for obtaining one:

You can apply to a prominent institution for a highly coveted position in a well-established program. *The Wall Street Journal*, NASA, Microsoft, the National Institutes of Health, the Smithsonian, and even the Supreme Court all offer internships for students at various levels of their educations. Of course, requirements differ with the target age group. Prestigious journalism internships often go to reporters in graduate school; internships that prepare students for the Westinghouse Science Talent Search go to very strong high school science students. Take the first step and inquire—to find out if the organization that gives you goose bumps has an internship program.

Learn about internships at places you may never have heard of by doing a little research. Talk to your guidance counselor, surf the Web, consult directories in your library, browse through handbooks in the bookstore, and talk to your network of contacts to identify options at less well-known institutions. Newer or smaller companies and state or local institutions are among the many establishments that, while not nationally renowned, may offer excellent internship opportunities.

Perhaps the organization that interests you doesn't have an internship program. **You may be able to create your own internship at the establishment of your choice.** Enhance your chances of creating and tailoring an opportunity by learning about the company or organization before you propose an internship.

Keep in mind the risks of pioneering as an intern in an organization that has never had one before. Make sure that you will have the structure, guidance, and support that you need; that your tasks will be reasonable as well as challenging; and that the quality of your life as an intern will fit your social and emotional needs. Be positive about what you can do, but also be realistic about who you are and the environment you require in order to be comfortable and do your best work.

Will you be paid for your internship? That depends. Some programs do provide financial compensation. In fact, prestigious, highly competitive internships for students who are at least at the college level can offer pay that is equivalent to a starting salary in the field. However, unless your financial needs are paramount, don't be heavily influenced by what an internship pays. An excellent unpaid internship will allow you to volunteer your time and abilities while making great personal and professional progress.

Ready to start exploring your options? Applying for internships, like applying to college, requires flexibility and planning. Be selective in deciding where to apply; at the same time, remember that lots of places receive many applications for a few intern slots. So improve your chances by applying to several establishments, including one or two that seem less competitive. It's worth it to secure yourself one of the best learning experiences around. ■

—Lesley Mackay

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Moving into the Workplace:
Internship and Volunteer Experiences

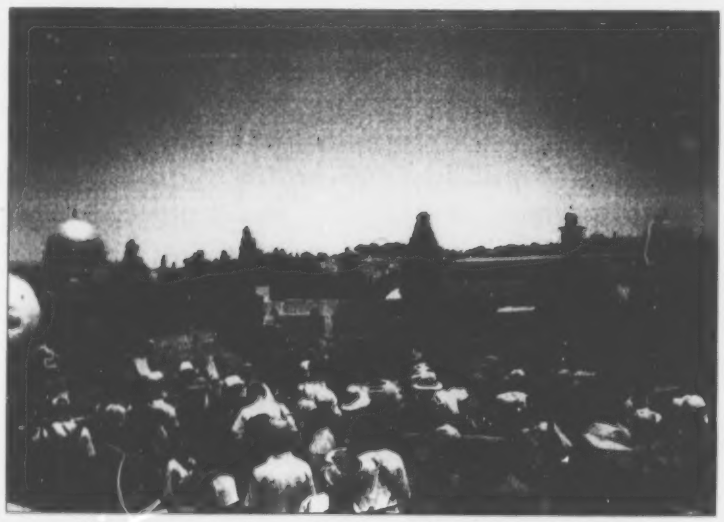
Picture yourself sharing research with interested colleagues in a state-of-the-art laboratory or assisting a patient during a blood transfusion. Internships and volunteer positions can provide access to such experiences—and unexpected rewards.

Summer Research—From Initiation to Immersion

by Vandana Madhavan

It all started with the Research Science Institute (RSI) held at MIT for rising seniors from all over the world. RSI was meaningful for me in many ways: I lived away from home for more than a couple of weeks, I fell in love with Boston, and I met wonderful friends. Most importantly, I conducted my first individual research—for five weeks I studied bacterial exopolysaccharide synthesis. Although I wasn't able to finish my project, I had the satisfaction of writing a formal research paper about what I had studied. In addition, RSI paved the way for a host of future opportunities.

Comfortable with traveling and eager for more experience, I enjoyed myself even more the following year at the Weizmann International Summer Science Institute in Rehovot, Israel. With some of my now-closest friends, I saw all corners of Israel from Jerusalem to Galilee to Eilat and the Negev. We learned about Jewish culture and even picked up a little Hebrew. The research experience was also remarkable—we worked in small teams and wrote short papers after only three weeks in the lab. Despite the time constraints, I was able to explore a new topic, biomineralization, and to taste the vast array of fields under investigation at the Institute.



Wiser, in Jerusalem (Dome of the Rock Al-Aqsa Mosque in background)

After Weizmann, I still had five weeks before starting my freshman year at Harvard. I had previously turned down a place in the Department of Energy summer program at Brookhaven National Laboratory (BNL) because it conflicted with Weizmann. Fortunately, however, a friend of a friend, who happened to work at Weizmann and at BNL, invited me to work at BNL for three weeks. (The grapevine works wonders—it never hurts to advertise yourself whenever possible!) Although I wasn't able to pursue my own research, I was exposed to yet another field, X-ray crystallography, and made some more research contacts.

I believe that my work at RSI, Weizmann, and BNL helped me obtain an internship at the National Institutes of Health (NIH) the summer after my freshman year. NIH attracts college and pre-college students from all over the US, but because it provides no social activities, it's more of a focused research experience than RSI or Weizmann. In the ten weeks I studied plasmid replication and partition, I accomplished more than ever. The following summer, I worked in the same lab on a different project, plasmid host-range, and again advanced a lot in ten weeks.

My summer research experiences, from my initiation at RSI to my immersion at NIH, have been immensely valuable. In addition to the fun and the friends (I still enjoy the reunions), internships have allowed me to explore a variety of fields through hands-on work. The laboratory experience I gained each summer improved my candidacy not only for successive internships, but also for the lab I chose for my senior thesis. In sum, I have gained many rewards from science internships and programs, and I would recommend them to anyone. ■

Vandana Madhavan is a senior at Harvard, where she is active in a singing group, college bowl, and volunteer work. She is currently working on her senior thesis in biology at Massachusetts General Hospital.

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Slugging it Out

by Carrie Shilyansky

If only that gill would move.

I was sitting on a lab stool somewhere between the UCLA Physiological Science Department and the Twilight Zone. It was the middle of summer, but I was shivering almost convulsively, alone in a locked and air-conditioned lab at 1:30 in the morning, concentrating all my energy on a pinned-down sea slug.

I had been sitting on that lab stool all day and most of the night for weeks for the sole purpose of pushing a button every five minutes to deliver a stimulus to a slug. Suddenly, the timer went off again, reminding me to push the button.

This time the gill contraction I elicited was large and shaped completely differently from the others. Had the gill contracted spontaneously? Or had the stimulus recruited a neighboring neuronal pathway? If the response was not random, it could be part of the mechanism by which the animal learned information about the stimulus. There were so many factors to consider—I was basically recording in black and white the process of learning in an isolated part of a simple neural system.

There were so many factors to consider—I was basically recording in black and white the process of learning in an isolated part of a simple neural system.

Before deciding to do this research project, I read literature in neurobiology and attended seminars at a nearby college for a couple of years. Having developed very specific questions and hypotheses, I applied to a local program that places high school students in research laboratories for a summer. After months of calling and visiting different professors, I found a lab where I could pursue my research relatively independently.

Of course, I didn't know everything I needed to know when I got there. (In fact, when I started trying to assemble my project at the lab, I not only completely mutilated the dissection, but also almost passed out doing so.) I had to do some more reading about sea slugs, their reflexes, and all the other technical details that you never pay attention to until you're putting together experiments on your own. Sitting there with a few books, articles, and a slug in front of me, I already felt a sense of accomplishment—I was using my own logic and information I had gathered to get my experiments working.

Before beginning my research, I didn't think I would be able to handle this level of experience on my own. Until my first experiment was over, I didn't think any of what I did would work. But eventually I created and carried out a true research project that even drew in other people from the lab. This gave me a lot of confidence in my own initiative and ideas.

Combining creativity, intuition, and logic, research is at once both a science and an art. Research in neurobiology is especially awe-inspiring. The brain is simply a mass of cells that can fire electrical impulses by creating ionic imbalances. The billions of electrical impulses fired into our brains are the thoughts, senses, and desires that define how we live. The translation from proteins and ionic imbalances in the brain to the relatively abstract concepts of learning and thinking is an incredible phenomenon. If we could begin to understand how it occurs, we could gain so much power to help people with various psychiatric and memory disorders, such as schizophrenia, attention deficit disorder, and Alzheimer's disease. If knowledge is power, then understanding the actual mechanisms behind knowledge and thought is the power to heal.

Combining creativity, intuition, and logic, research is at once both a science and an art.

Being part of the community of that UCLA laboratory helped me mature as a researcher and a student. I had enormous respect and admiration for my mentor and co-workers, and it was amazing to be interacting and discussing my ideas with them. In addition, I was excited to get original results and contribute to the laboratory. Those two summers offered a glimpse of the frustrations and thrills of real research, and could not have been better spent.

I would never have expected so much from studying a simple sea slug. ■

Carrie Shilyansky is a freshman at Caltech. She won second place in the 1997 WSTS for the study of habituation described above.

Giving and Getting a Future

by Darin Supparanich

I have been volunteering at Western Wake Medical Center for four years now, and it is definitely the most important thing I've ever done. I had signed up to volunteer in the summer of my sophomore year simply to obtain a brief community service experience. But by the end of the summer I knew that I would be returning to Western Wake for a long time.

My ongoing work at the hospital is not always glamorous—I learned early that the television portrayal of hospitals is not always accurate. In fact, the work can be tedious at times: filing paperwork, answering phones, or sitting at the information desk just waiting for someone to come through the door. After the completion of a full shift of work, however, whether the tasks involved led me to the emergency room, outpatient surgery, volunteer office, or other departments, I leave with a satisfaction that is unique to this community service.

One particularly transforming experience took place in the outpatient surgery pre-op room, where I assisted a man undergoing a blood transfusion. Because of a prolonged hospital stay when I was younger, I had a strong aversion to needles, and I had no desire to learn anything about transfusions. But there I was, offering blankets to a man who had lived most of his life on blood that wasn't his. I spent most of my shift standing nearby; he alternately rested and spoke to me, mostly about how much he couldn't wait to go home.

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To my surprise, the whole situation fascinated me: how the blood wasn't pumped into him, but dripped slowly from the bags into the tubing; how he was totally aware the whole time; how each moment he seemed to become stronger and more animated. When the procedure was over, he asked that I be allowed to escort him to his family. I pushed his wheelchair to the parking lot, where he thanked me for all I had done. It's impossible to describe the satisfaction I felt when he waved to me from the window of his family's car.

Volunteering has given me many valuable experiences, all of which have influenced my desire to pursue a career in medicine.

I was so inspired by this experience that I became involved in the blood drive effort. When the National Honor Society planned our school's annual drive, I became a student recruiter, urging people to consider the impact of donating blood. As expected, many students shrugged or claimed a fear of needles. I was pleased, however, to see most of these same people slowly consider what I had said and agree to sign up. The blood drive was the most successful ever at Apex High School.

Volunteering has given me many valuable experiences, all of which have influenced my desire to pursue a career in medicine. No other opportunity has taught me more effectively how to face unexpected situations and act accordingly. No other opportunity has allowed me to interact with so many people in my community. Most of all, no other opportunity has allowed me to have such a positive effect on other people's lives. ■

Darin Sujavanich is a

INTERNSHIP & VOLUNTEER OPPORTUNITIES IN BIOLOGICAL SCIENCES

Brandeis Summer Odyssey Science Research Internships
Rabb School
Brandeis University
P.O. Box 9110
Waltham, MA 02254-9110
(617) 736-3424

Brookhaven National Laboratory
Educational Programs
14 Brookhaven Avenue, Bldg. 438
Upton, NY 11973
(516) 282-7171

Dr. Bessie F. Lawrence International Summer Science Institute
American Committee for the
Weizmann Institute of Science
51 Madison Avenue, Suite 117
New York, NY 10010
(212) 779-2500

High School Honors Science Program: Research Internship
Dr. Gail Richmond
Michigan State University
330 Erickson Hall
East Lansing, MI 48824-1034
(517) 353-2958

Interdisciplinary Program in Biological Sciences with Emphasis on Research
Rick Pomeroy
Division of Education-Science
University of California-Davis
Davis, CA 95616
(916) 752-0622

National Cancer Institute Student Research Training Program
National Cancer Institute
National Institutes of Health
Equal Employment Office
Building 31, Room 10A33
9000 Rockville Pike
Bethesda, MD 20892
(301) 496-6266

NIH Summer Internships
National Institutes of Health
Office of Education
10 Center Drive, MSC1158
Bethesda, MD 20892-1158
(301) 496-2427

Research Science Institute
Center for Excellence in Education
7710 Old Springhouse Road
McLean, VA 22102
(703) 448-9062
cee@pop.erols.com

Student Conservation Association
P.O. Box 550
Charlestown, NH 03603-0550
(603) 543-1700

Summer Research Training Program
Dr. Dudley Cox
Department of Biological Sciences
Pace University
1 Pace Plaza
New York, NY 10038
(212) 346-1895

Wisconsin Youth Apprenticeship Program
BioPharmaceutical Technology
Center Institute
Contact: Karin Borgh
kborgh@promega.com
(608) 273-9737

Youth Conservation Corps
Human Resources Programs
U.S. Forest Service
U.S. Department of Agriculture
P.O. Box 96090
Washington, DC 22209
(703) 235-8834

For more information about internship and volunteer opportunities, see the following resources:

Directory of Student Science Training Programs for Precollege Students. Washington, DC: Science Service Inc., 1994. (202) 785-2255.

Gilbert, Sara Dulaney. *Internships: The Hotlist for Job Hunters*. Indianapolis: Macmillan, 1997.

Grand, Gail L. *Student Science Opportunities*. New York: John Wiley & Sons, Inc., 1994.

Higman, Susan, ed. *Jobs You Can Live With: Working at the Crossroads of Science, Technology and Society*. Washington, DC: Student Pugwash USA, 1996. (202) 393-6555.

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So You're Thinking About Medical School ...

Interview with David Trabilsy, Assistant Dean for Admissions at The Johns Hopkins School of Medicine

Many of our readers are already thinking about medical school. Will their high school transcripts play a role in their eventually gaining admission to medical school?

The whole process of education has to be seen as a continuum—what students do in high school will affect the choices available to them for college, which will then determine the strength of the program that they major in. We do not look at high school work in the medical school admissions process, but it plays an important part along the way.

Can students who go to less selective colleges be competitive in the application process?

Absolutely. At Johns Hopkins, we have admitted students from small liberal arts colleges, larger prestigious private institutions, and state universities, and they perform equally well. However, some medical schools rate the undergraduate institution in their initial review process, giving applicants from more competitive schools slightly greater weight than applicants from less competitive schools. So the strength or reputation of the program may be a factor at some medical schools, and it's certainly something to consider in deciding where to attend college.

What about choosing a major? Can a student with a humanities major be a competitive applicant to medical school?

It's entirely possible. And I would encourage students to major in the area that is of greatest interest to them, to enjoy learning for its own sake. I should point out, though, that non-science majors do have to complete the core science requirements that are prerequisites for medical school work—typically a year of biology, a year of general chemistry, a year of organic chemistry, and a year of physics, all with labs. Some schools, like Hopkins, require a course in calculus as well. Non-science majors must perform very well in these courses. Because they're taking a smaller number of science courses than a science major would take, there is less margin for mediocre grades. So non-science majors must be strong in two areas: in their major and in the core science work.

Photograph ©Bill Denison

Suppose a student decides very late to go to medical school. Is there a way catch up on all that science work?

We're seeing more and more students applying to medical school after they have graduated from college or even after pursuing careers. There are a number of post-baccalaureate programs throughout the United States that provide the courses required for medical school. Some are organized to allow a student who's had no science work to complete all of the requirements in a year, while others tailor a program for students who don't need as many courses.

What about students who apply to medical school at a younger age? Are they adversely affected by being younger than the traditional applicant?

Our review process is age-blind. We consider many criteria when evaluating applicants—academic performance, personal essays, letters of recommendation, and involvement in extracurricular activities—whether music, art, athletics, community service, or other activities. We also look for the maturity and interpersonal skills that we would want to see in a future physician. We seek candidates who are strong in those areas—no matter what their age.

There are some issues for accelerated students to consider, however. It's important that they don't compromise the experiences that are not academic in nature. This could affect their personal development, which could then have an impact on the next step, whether it's undergraduate work or medical school admissions.

Another serious issue is the source of motivation for attending medical school. Is the student truly drawn to medicine as a career? Or has the decision been heavily influenced by parents or others? This concerns me because of the potential negative impact later on when the student discovers what he or she truly wishes to do.

Do you have any final advice for our readers?

I would encourage students not to view education as simply a means to an end. High school, college, medical school, and even residency are more than just a lot of time before an endpoint at which one can practice medicine. Those years along the way have their own intrinsic rewards. It's very important for high school students to remember that because there's a long period in which they may feel that they are delaying gratification.

I would also encourage young people to consider medicine as a career that is extremely satisfying. It's a profession in which one can apply knowledge in a way that directly improves the quality of people's lives. ■

—Melissa Hartman

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LESSONS LEARNED FROM *ER*

"Medicine requires a balancing of commitments: to patient care, to continuous learning, to society, but also to family, to friends, to self. Of all the challenges I faced in med school, the hardest was finding a balance that was right for me. Most highly able students don't have much problem with the academics; it's the personal issues that require the most adjustment."

—Second-year resident in pediatrics

On the television series *ER*, some of the doctors' toughest challenges have nothing to do with medical know-how; they have to do with *self*-knowledge. Here, we offer some advice from young residents about things you can do now to help prepare yourself for this exciting and demanding profession.

Preview the World of Medicine

Last May, *ER*'s Dr. Carter ruefully realized that he was in the wrong residency—that emergency medicine, not surgery, was his true calling. He made his initial choice without thinking carefully enough about which field of medicine would bring him the greatest personal satisfaction.

Our sources agree that it's never too soon to start considering such things. First, get a good look at what a doctor's life entails; make sure it's for you. Volunteer at a hospital. If you can, follow a doctor around for a few days: "I spent three days trailing a psychiatrist and a fourth day witnessing a liver transplant. Both of these were exciting enough to clinch my decision to enter medicine." Don't be too dazzled by the clamor and excitement; notice the tribulations as well as the triumphs. It's work that asks a lot of you. "Medicine *demands sacrifices* in terms of relationships, hobbies, etc. A person must truly be dedicated to stay in it."

Because different kinds of medicine offer very different challenges and rewards, it's helpful to survey a range of specialties. One M.D. confessed, "As a fourth-year med student, I was still going on rounds with doctors to see different specialties and approaches to medicine. I honestly wish I'd spent more time working in a hospital when I was younger. I'd advise others to try to experience a variety of environments within medicine, to gain an appreciation for the diversity of the field." You can start exploring now, while there's no pressure to decide.

Learn for Life

You don't see the interns on *ER* catching up on the great books they didn't read in college (although Dr. Weaver, one of the attending physicians, somehow found the time to write a novel!). Once med school starts, opportunities to pursue other interests become limited. As one young resident discovered, "Medical education means immersing yourself in—and giving up much of what isn't—medicine. For me, the hardest adjustment has been the extent to which I've had to put my non-medical interests on hold."

Because medical education *is* so focused, many students treasure the time they spent exploring other interests during their premedical years. As one M.D. recalls, "Even though I knew I was headed for med school, I majored in physics because it's the subject that interests me most. Med school courses are very comprehensive; it's unnecessary to restrict yourself to premed courses in college—especially when there's so much else to explore." Another added, "As an undergrad, I gained a solid grounding not only in science but also in humanities. Art and literature may not be directly relevant to med school, but their importance to me as a person is unquestionable. I'll be a better doctor—and human being—for having spent that time developing other facets of myself."

Develop Your EQ: Emotional Intelligence

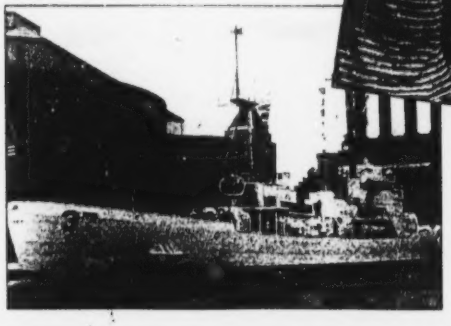
ER's Dr. Benton is learning the hard way that a brusque manner is not a professional asset. Good people skills are valuable not only in dealing with patients but also in getting along with colleagues. Much of medicine involves teamwork, and good interpersonal skills are a definite asset in an environment where every second may count. One M.D. reflected, "A student who mixes well as an undergrad should do well in med school, but loners might struggle with the pressure. You need to be able to work well with others even while demanding a lot of yourself."

Effective stress management is another important aspect of EQ. "Emotionally, there's quite a bit of pressure, both external and internal. You need to be able to pace yourself and keep things in perspective," emphasized one resident. To handle the pace, "You've got to be hard-working and disciplined, but you've also got to be able to cut loose and let off steam somehow." Whether it's running, basketball (Dr. Greene's personal favorite), yoga, or folk dance, find an activity you enjoy that provides a good release and that helps you stay healthy when pressure builds.

In med school, pressure comes in many forms. For some, it's the sheer volume of material that must be mastered. For others, it's coming to grips with the realization that people's lives will depend on how well you learned your homework. Still others find it hard, at times, to hang on to their sense of self in the midst of such a highly structured program. As one M.D. put it, "There are a lot of hoops to jump through. You need to preserve your identity while at the same time following a fairly narrow path through medical training—and that can be a difficult balance to maintain." Exploring your interests and thinking about your priorities beforehand can help you find that balance. It's easier to stay on a path laid out by others if you have a clear sense of who you are and why you're there.

Despite their complaints and caveats, most med students wouldn't want to be anywhere else. One M.D., voicing the feelings of many, said, "Med school took me on a breakneck-speed tour of the fascinating things that are known about human disease and healing. Now I'm in a position to use that knowledge to help people. I couldn't be happier doing anything else." ■

—Carol Blackburn



What did you bring with you to school this year—besides a backpack filled with pens and notebooks? If you participated in an academic summer program, you brought a new understanding of math, science, language, or another interesting discipline; a new confidence gained from interacting with your intellectual peers; and a renewed appetite for learning.

Summer programs provide the perfect opportunity to immerse yourself in an area that intrigues you. Surrounded by other students who share your interests, and with the support of excellent instructors and teaching assistants, you can explore topics in depth by reading, discussing, and investigating. In this community of learning, the fun and challenges that you crave during the school year come to life.

If you're interested in biology, you'll find numerous programs that provide hands-on learning in specific areas, such as neurobiology and genetics, that you might not study in depth in a high school classroom. The students pictured on these pages participated in IAAY summer programs in marine ecology or paleobiology. These courses combine classroom education, laboratory activities, and field work to engage students in intensive learning experiences.

Some students' field work involved collecting fossils, while others conducted research at shoreside sites on the Chesapeake Bay or sailed along the East Coast to compare estuary systems. Whether they were learning paleontological techniques, dissecting squid, or monitoring whale populations, these students all got a realistic taste of what a biologist's life involves.

These photos are just a sampling of their experience. We hope you'll see in them not only a glance back at the summer, but also a preview of what's possible for you.

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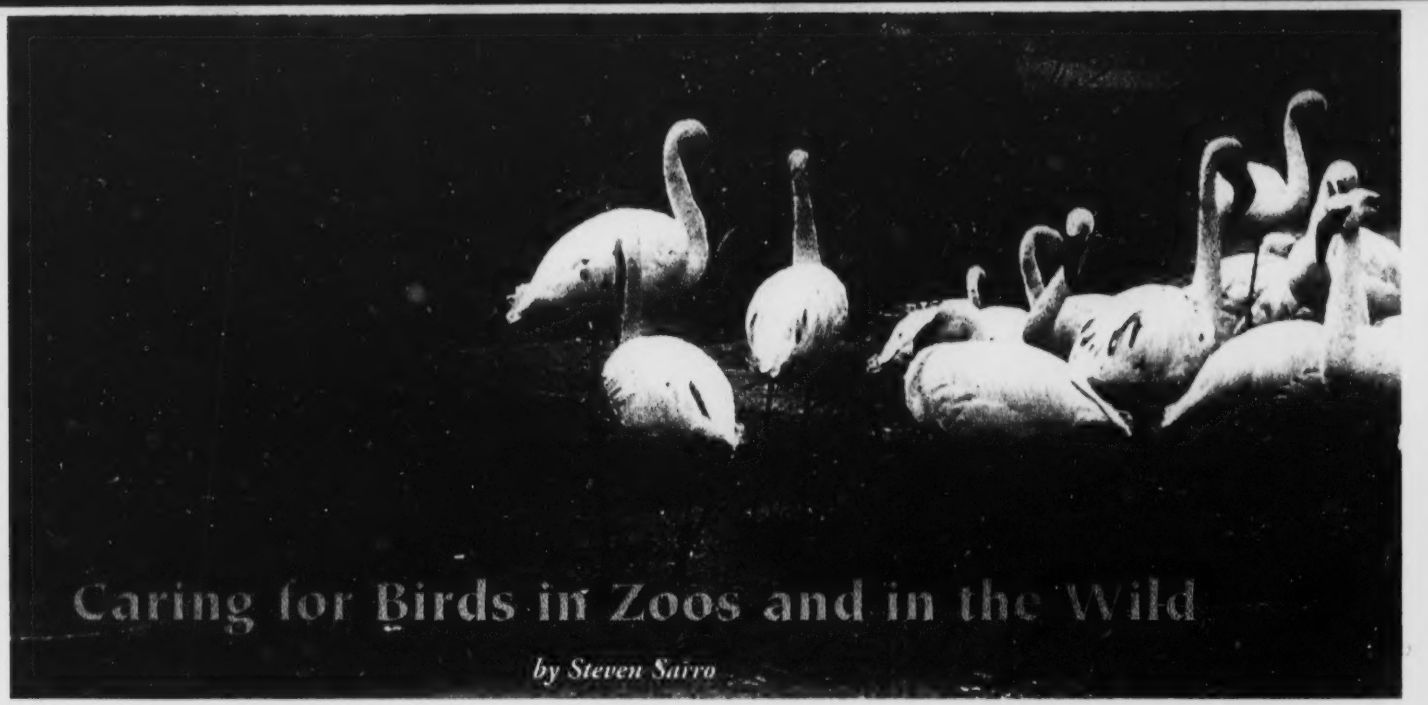
Visit the Web sites created by these marine ecology students at
http://www.livingclassrooms.org/latest/caa/index.html



Caring for Birds in Zoos and in the Wild

by Steven Sarro

As bird curator at the Baltimore Zoo, I monitor our birds' daily care, maintain their habitats, keep records on them, oversee their mating, and acquire new birds. In addition, I work both inside and outside the zoo for the preservation of dwindling species such as the African penguin and the Bali mynah.

Many people see zoos as exotic recreation centers. However, curators and keepers are typically motivated by a strong environmental commitment. We try to make zoos complex places that can both entertain and educate. We want to strengthen visitors' ties to the natural world so that they will help to protect it.

Zoos and Natural Habitats

Wattled Cranes

Decades ago, zoos may have helped to deplete some natural animal habitats. However, at today's zoos we provide a relatively safe haven for endangered species; we nurture and breed them; when conditions permit, we may even initiate reintroduction of animals into a native setting.

The health of our animals is important not only for their well-being, but also for the advancement of the relationship between zoos and nature. Zoo animals resemble strong, healthy specimens in the plains, jungles, trees, and rivers from which they or their ancestors came. And so zoo health care involves not only daily nurturing and medical treatment, but also genetic management. A genetically healthy population is genetically diverse, so we strive to limit both inbreeding and over-breeding.

Currently, zoo and native populations remain mostly discrete. Because of cost and other logistics, few animals go back into the wild. One important limiting factor is that, in many cases, the forces that have made an animal endangered or vulnerable still exist. For example, Bali mynahs are often taken from the wild and domesticated as household pets. It doesn't make sense to reintroduce these birds into the wild to be plundered by the human population.

With education, commitment, and effort, many environmental hazards can be reduced. We look forward to the day when zoos and natural habitats interact in a more fluid, balanced way. In anticipation of this development and in the interests of good housekeeping, we keep complex records on our zoo populations. For example, I maintain a studbook of the approximately 650 African penguins in captivity in North America. In my record-keeping, I follow demographic developments, charting ancestry and patterns of breeding.

Joe McSharry, The Baltimore Zoo

African Penguins

Respecting Lovable Creatures

Before I became bird curator, I worked for ten years as bird keeper and, then, senior keeper. During that time, I, like most of our visitors, was a great fan of our birds. I was susceptible to the flamboyant charms of an outgoing crane, the endearing chatter of a colorful parrot. I still notice how easy it is to become enamored of a particular creature.

However, becoming infatuated is not the best way to respond to animals in the zoo.

Our animals are not pets, and a healthy perspective is required in order to care for them. Difficult decisions must be made about care; farewells must be made when animals die.

Zoo professionals try to create attractive settings for the human enjoyment of wild creatures. But we hope that visitors will not find coming to the zoo a totally satisfying experience. Zoo animals are present, fully available to be seen and enjoyed. But many of their relatives are entirely absent, having disappeared from our planet.

Wild creatures face a tremendous challenge—survival. Will we protect them or let them vanish? Around the world, zoos are educating people about disappearing habitats, threatened animals, and the steps we must all take to save them. ■

TAKE ACTION ON BEHALF OF BIRDS . . . AND THEIR HABITATS EVERYWHERE.

Birds are amazingly hardy and extremely fragile at the same time. Each year vast numbers of them undertake arduous transcontinental migrations. Yet a bird that can make a five-thousand mile journey across the Americas may not survive the destruction of a single habitat along the way. Priceless nurturing grounds exist everywhere—in the rainforests and grasslands of other continents, in the small woods and simple fields of our own hometowns.

Join a bird-watching society to educate yourself about local birds and their needs. Contact your local zoo and ask them about area conservation programs and ornithological societies. Find out what the National Audubon Society or the Sierra Club is up to in your region and beyond. Or join an environmental organization that focuses its attention overseas such as the Rainforest Action Network.

Remember, anything you do to improve human stewardship of the environment will help birds everywhere. Reducing plastic consumption in your home or school, participating in recycling, and helping to educate your community about the impact of proposed local construction projects are all excellent steps to take.

National Audubon Society
Membership Department 5WEB
P.O. Box 52529
Boulder, CO 80322-2529
http://www.audubon.org

Sierra Student Coalition
145 Waterman Street
Providence, RI 02906
http://sierraclub.org

Rainforest Action Network
450 Sansome Street, Suite 700
San Francisco, CA 94111
http://www.ran.org

Photograph by Gary K. Ostrander

"Only in the last moments of human history has the delusion arisen that people can flourish apart from the rest of the living world."

— E.O. Wilson, 1994

Twenty years ago, the coral reefs surrounding the Galápagos Islands teemed with life. Yellow-and-white-striped butterfly fish poked their long snouts into coral crevices to eat the tiny animals hiding in them. Electric-blue and yellow damselfish glided through the coral's pink, yellow, and green arms as the rubbery tentacles of anemones swayed in the current.

Today, the same reefs are bare. Most of the fish, plants, and animals are gone, and the arms of the once-colorful coral are dead and overgrown with algae. More than 90 percent of the coral reefs surrounding the Galápagos Islands are now completely devastated. Sadly, the fate of these reefs is not that unusual. Scientists estimate that 10 percent of the world's coral reefs are dead, and nearly two-thirds are in peril.

Biologists, toxicologists, environmentalists, and public officials are working together to ensure that coral reefs will survive. Unless we work to reverse the destruction, we may forever lose our planet's second most diverse ecosystem.

Rainforests of the Sea

Often called "the rainforests of the sea," coral reefs are home to almost one quarter of all marine life—nearly one million species of aquatic animals and plants. These complex environments are essential not only to the species that inhabit them, but also to other marine animals and ecosystems. For example, mangrove forests, which grow in shallow water, and sea grass beds are two ecosystems interconnected with the health of coral reefs. Reefs protect the mangroves and sea grass beds from rough waves, allowing them to flourish. In exchange, they protect the reefs from sedimentation. If the reefs are destroyed, these ecosystems will struggle, and manatees and other marine life that depend on them will suffer.

The health of coral reefs is important to humans, as well. The shallow barriers of the reef protect coastal areas from storms by reducing the effects of waves on the beaches. Many developing nations depend on the reefs for food and for the tourist dollars they attract. In addition, coral reefs are a potential source of new medicines—nearly 6,000 unique chemical compounds have been isolated from reef-dwelling species, including several possible cancer medications.

Telltale Signs of Decay

Over the past twenty years, scientists have noticed a pronounced increase in coral bleaching, a sign that the coral is suffering environmental stress. Coral, as we know it, is actually thousands of tiny animals, individually referred to as polyps. Coral polyps live within the hard external skeleton—what we refer to as coral. This protective skeleton is created by the coral polyps with the help of a one-celled algae that lives within their tissues. This algae, called *zooxanthellae*, uses photosynthesis to convert sunlight to food and energy for the coral. The coral depends on *zooxanthellae*, which give coral its color, for survival. If the coral's environment changes, the *zooxanthellae* are expelled from the polyp's tissues, the coral dies, and the white of the skeleton becomes visible. From 1876-1979, divers recorded only three cases of coral bleaching; from 1979-1990, they saw more than 60 cases.

Spurred by the global increase in coral bleaching, the U.S. State Department created the International Coral Reef Initiative in 1994. This group, comprised of more than 50 organizations from around the world, has asked scientists to participate in long-term reef monitoring projects. Professor Gary Ostrander, Dean of Research at the Johns Hopkins University and previously Director of the Environmental Institute at Oklahoma State University, was asked to take part in the Caribbean Coastal Monitoring project, one of these cooperative ventures. Ostrander and other scientists work in conjunction with representatives from 15 other countries to monitor the coral reefs surrounding San Salvador, a tiny island in the Bahamas.

Over the past several years, Dr. Ostrander has noticed a disturbing trend. "I'd heard about bleaching in other parts of the world, but had never seen it in San Salvador. I thought, naively, it's not going to happen here. Then, all of a sudden, it appeared." Dr. Ostrander has also observed the effects of the increase in bleaching. As the coral reefs decline or die, the numbers of fish and species of fish also decline.

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The Impact of Humankind

Scientists aren't sure of all the reasons for the decline. Nor are they always sure of which causes affect which reefs. Natural events, like hurricanes and temperature fluctuations, have an impact on the reefs, but directly or indirectly, human activity is the primary cause of coral deterioration.

Pollution—sewage, agricultural run-off, chemicals, and oil—disturbs the environment of the reef. The coral need shallow, clear water for photosynthesis. If oil or silt contaminate the water and block sunlight, the coral may die. Boaters crush the coral's fragile skeletons with anchors, and divers can kill the coral polyps simply by touching them.

George Grall, The National Aquarium

Destructive fishing practices are also devastating the reefs. Fishermen sometimes use explosives, which destroy the coral skeletons, or poisons like sodium cyanide, which only stun the fish, but kill the coral polyps. Even overfishing can harm the reef.

"All the different species of fish in a reef are in balance with each other," explains Ostrander. "For example, groupers and snappers feed on butterfly fish, and butterfly fish feed on coral. If you pull out the big predators, the population of coral-eating fish will explode. So the normal balance between coral growth and coral loss is no longer there. The same thing is true with algae and some invertebrates that live on the reef—everything can get thrown out of balance."

Human impact on the reef can also be indirect. Coral is very sensitive to temperature and UV radiation. A temperature increase or decrease of only a few degrees can be fatal. If global warming raises the sea surface temperature, the coral may die. Also, our destruction of the earth's protective ozone layer is allowing more UV radiation to reach the reefs, which also may increase the occurrence of coral bleaching.

Preservation Efforts

Because coral reefs border a significant number of countries, and the oceans that support them are affected by everyone, efforts to preserve the reefs must be global. The International Coral Reef Initiative has sponsored symposia on reef health, preservation efforts, and international projects. This group also named 1997 "International Year of the Reef" to help raise the public's reef awareness.

Kim Morris-Zarneke, Conservation Coordinator at the National Aquarium in Baltimore, notes that the Aquarium is working to educate the public about reef decline and to support preservation efforts. They participate in the Caribbean Coastal Marine Monitoring project in San Salvador, and have constructed a large Atlantic Coral Reef exhibit. As part of their Reef*Action* project, they installed a "parking meter" in the reef exhibit, which has raised over $20,000 since 1995. "This money goes to Parque Nacional del Este in the Dominican Republic," notes Morris-Zarneke. "The donations have been used to build a visitors' center, buy diving equipment, and produce over 40,000 educational brochures on reef conservation in English and Spanish."

The commitment to preserve and protect must extend far beyond government agencies and environmental groups. Individuals can make a big difference in helping to protect the reefs and the oceans. Recycling and conserving electricity can reduce the amounts of greenhouse gasses in the atmosphere; conserving water can decrease the amount of runoff; helping to reduce pollution will keep the reef's waters clean and clear. In addition, you can volunteer or intern at your local aquarium. By taking steps now to protect coral reefs, you can help preserve them for lifetimes to come. ■

WAYS YOU CAN HELP SAVE THE REEFS:

- Do not purchase jewelry or products made from coral.
- Don't use chemical pesticides or fertilizers; even if you live thousands of miles away from a coral reef, the pollutants can filter into the watershed and ultimately affect the shallow waters that support coral reefs.
- Recycle, conserve water, and don't pollute!
- Switch to energy-efficient light bulbs. Besides saving money on electricity, they reduce the amounts of carbon dioxide, nitrogen oxide, and sulfur dioxide—three pollutants responsible for greenhouse gas, smog, and acid rain.
- If you dive or snorkel, don't touch the coral. It could break, or you might hurt some of the delicate polyps.
- If you visit a reef, make sure your boat doesn't hit any coral. And don't drop anchor—it could destroy the reefs.
- Adopt a reef through the Center for Ecosystem Survival, or become a member of your local aquarium.

—gathered from the National Oceanic and Atmospheric Administration and the National Aquarium.

Selected Resources

The Center for Ecosystem Survival
(415) 338-3393

National Aquarium
(410) 576-3800
www.aqua.org

National Oceanic and Atmospheric Administration
(202) 482-6090
www.noaa.gov/public-affairs/coralreef/

Reef Check
www.ust.hk/~webrc/reef.html

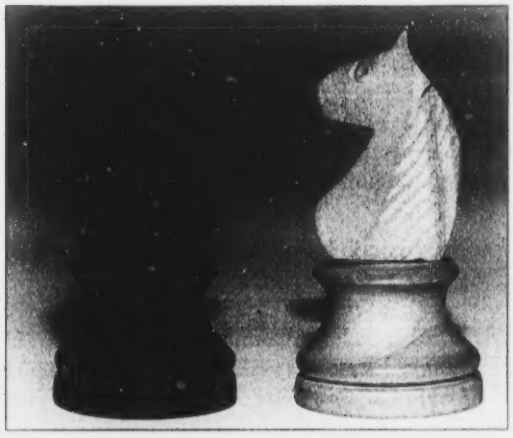
21 BEST COPY AVAILABLE

Strategizing for Fun and Learning

The Fun and Challenge of Chess

by Kathryn Turner

This year I competed in many chess tournaments, including the SuperNationals in Knoxville, Tennessee. After a tournament, I close my eyes, see the layout of a game, and visualize how the pieces were moved. I have been playing the game so much that when I walk, I picture a bishop swooping across a chess board.



I have found innumerable benefits in playing chess. Besides the fact that it provides countless hours of enjoyment, the game also offers the thrill of competition and constant opportunities to improve logical thinking skills.

The most important element of chess is strategy. Without a strategy, it is impossible to win even a single chess game. Strategizing in chess requires players both to visualize the game three or four moves ahead and to react flexibly—to have a plan, and also to be able to adjust the plan. In this respect, chess is similar to Monopoly, sports, even war. In sports, for example, players must have a capacity to predict their opponents' responses to a particular play. They must also be able to recover if their opponents do not respond as anticipated. Likewise, chess players must have a backup plan at all times.

Chess has not only increased my ability to strategize, but also developed my analytical skills. Chess relates to many academic disciplines, particularly math. In chess, you need to consider all the pieces; in math, you need to consider all the variables. Both activities involve manipulating the elements of a problem and considering possible next steps. Mathematical problem-solving can be enhanced by adopting the strong tactical outlook required in chess.

Within mathematics, chess seems most related to geometry. Like chess, geometry requires a visual understanding in order to formulate a strategy for solving a problem. Geometric problems involve visualizing a figure, planes, or a sphere. In chess a player must "see" what the board would look like after moving a particular piece before deciding what tactic to take.

Yet chess strategy can take many forms. In one of my most satisfying games, I used a psychological tactic to foil my opponent. Before each move, I looked hard at every piece on the board. My opponent began getting annoyed and timing my turns with his watch. Little did he know that I had set up a brilliant checkmate; I moved slowly so he wouldn't catch on that something was about to happen. In my fourteenth move, I stared hard at my knight and then casually changed its position.

My opponent never saw the checkmate coming. ■

Beginning high school in Houston, Texas, this fall, Kathryn Turner will continue accelerated studies in science and math. In addition to playing chess, Kathryn reads, writes, and acts in her spare time. She plans to pursue a career as a scientist and hopes one day to visit Mars.

Computing and Competing at Chess Tournaments

On May 17, 1997, the University of Maryland at Baltimore County, home of the top U.S. college-level chess team, hosted an exciting two-part chess event. On one side of a large room, dozens of middle and high school students sat at long tables playing 7-minute games of "blitz chess" in the hope of qualifying for Maryland's All-Star Scholastic Team. Amidst loud chatter, these players slapped special time-clocks on, plotted, advanced a knight or a pawn or a rook, slapped their clocks off, and waited for their opponents' counter-moves. As a game ended, each competitor got up, stretched, and, looking a little dazed, went hunting for a new contender.

On the other side of the room, a new national event was unfolding for the first time. In Chess Jam 1997, sponsored by the U.S. Chess Federation and the Kasparov Chess Academy, internationally renowned chess masters simultaneously took on each member of a nationally ranked precollege scholastic team. Chess Jam's clocked "simuls" gave young people both the thrill of tournament play and a unique opportunity to compete against a renowned master.

Jennifer Shahade, an 11th grade member of the top-ranked eight-person chess team from Masterman School in Philadelphia, faced off against the Russian Grand Master Alex Yermolinsky. A National Master herself, Jennifer has competed in chess since the fourth grade. She writes for the U.S. Chess Federation's publication for students, *School Mates*.

Jennifer eventually lost her game. Looking pensive just afterward, she commented that Yermolinsky "started with a great initiative. I couldn't consolidate my pieces during the endgame." But Jennifer brightened as she noticed that one of her schoolmates was hanging on against Yermolinsky. "Most people don't realize it," she said before disappearing into the crowd surrounding their game, "but chess is a social activity."

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Chess is social, as well as competitive and instructional. Because of the many-faceted nature of the chess experience, chess fervor is currently spreading around the world. Young people everywhere are playing the game with family members, friends, teammates, and experienced masters. When live partners are not available, inexpensive software can provide a sharp electronic competitor.

Jennifer Shahade takes on a Grand Master.

The inaugural Chess Jam event featured Garry Kasparov, the world's best human player. Kasparov conducted a simul just days after losing his arduous match against the 1.4-ton IBM supercomputer, Deep Blue.

As the world witnessed in the Kasparov-Deep Blue match, a computer with enormous computational power can play brilliant chess. A powerful machine's capacity to assess the extended results of all possible moves can enable it to thwart a plan generated by even an unsurpassed human player. The computer has other advantages as well: as Kasparov explained at UMBC, "if the computer loses, it doesn't know that it loses." The computer's steely lack of self-consciousness prevents it from experiencing any negative effects due to a failure or the possibility of a failure.

But humans also bring special qualities to chess. As chess player Kathryn Turner discusses on the facing page, people possess spatial ability—the capacity to visualize relations among objects. In chess, spatial skills can streamline the computational process.

Competitive chess requires concentration.

Using the ability to visualize different constellations of pieces on the board, a human player can operate from an insightful, creative, and, possibly, winning perspective on the game.

Day-long chess tournaments demand not only inner strengths, but also great physical stamina. Allan Sherman, sponsor of the UMBC's top-ranked chess team, thinks that the U.S. should follow Russia's example and categorize chess as a sport. Recognition as a sport might lead to the inclusion of chess in the prestigious Olympic Games—might even change the way we think about sports forever.

But whether or not chess makes it into the Olympics, it may soon become part of your regular school day. Addressing a large, affectionate audience before conducting his Chess Jam simul, Garry Kasparov explained that his next project was to fly to Israel, where chess curriculum that he helped develop in Russia is being introduced into the schools. He added that if his curriculum is shown to benefit Israeli students, it will then be offered to schools in the United States. Judging from the overwhelming enthusiasm at the UMBC event, this quiet game could truly ignite the classroom. ■

—Lesley Mackay

Players must visualize the chess board three or four moves ahead.

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Exploring Career Options: Feature Writing

Interview with Lisa Pollak

by Lesley Mackay

Lisa Pollak, 28, a reporter at the Baltimore Sun, won the 1996 Pulitzer Prize for Feature Writing for her story on the family of baseball umpire John Hirschbeck, whose two sons suffered from a rare genetic disease. Hirschbeck had been caught up in a media blitz months before when a Baltimore Orioles second baseman spat on him after a call. Ms. Pollak's article brought to light, as she describes it, "this human story underneath all the baseball stuff."

What is feature writing, and what makes your feature writing distinctive?

Feature writing involves telling all kinds of stories, from the serious to the lighthearted, in a nontraditional way. For me, it often means going back to a big news story and looking for what's behind the news, the human side of things that no one has expressed.

My stories are often different from news stories not only in approach, but also in structure. Journalistic articles typically present the most important facts first and then taper into less and less significant details. My stories unfold more like novels or movies with a beginning, a middle, and an end. I develop my characters gradually. I hope to make my readers feel something for them.

How long have you been writing stories like that?

Since I was sixteen years old. The summer after my junior year, I attended the National High School Institute at Northwestern University, a summer program with a variety of course offerings, including journalism. I spent five weeks there writing stories and getting edited, and I loved it.

Before that summer, I had enjoyed writing, but had struggled with trying to make stories up. I was always disappointed with what my imagination produced. At the institute, I realized that I could marry storytelling and journalism, write narratives about true stories and real people.

What are the challenges for you in writing a major article?

I have to do a great deal of background work before I feel ready to write. I have to meet people, talk with them, and ask lots of questions before I possess the sense of authority that allows me to sit down and write.

Once I begin, I have to be patient with the fact that I write slowly. And I have to get comfortable writing in a busy newsroom.

While my writing requires lots of preliminary research and thinking and while I don't find the writing process easy, I usually feel confident that other people will find something special in my stories.

In the article on the Hirschbecks, you write in a very slow, understated style, and you use lots of sentence fragments. How did you decide to write in that voice?

As a writer, you can't just go out and get a voice—you have to develop one by exercising one. Your voice is made up of your experiences, everything you've read, everything you've felt.

After your experience in the summer program at Northwestern, how did you make progress as a writer?

As a senior in high school, I wrote to all the newspapers in my area, even to the biggest one, the *Detroit Free Press*, asking for an opportunity to write. It was very naive of me, but I did get one reply, from the *Detroit Jewish News*. The editor met with me and encouraged me to submit story ideas. My first professional publication, in the *Detroit Jewish News*, was about new trees planted at a local Jewish Community Center.

That experience was followed by three internships and other freelance jobs. I got my first real job as a journalist after graduate school.

What did you study as an undergraduate and in graduate school?

I earned an undergraduate degree in American culture, an interdisciplinary field, at the University of Michigan. I chose this focus because I thought that it would provide me with a good general background for being a reporter. I also wrote for my college newspaper. Then I went on to study at Northwestern's one-year graduate program in journalism.

Since you had been writing seriously since you were sixteen, did you find it easy to get your first internship?

No. I applied to more than a hundred newspapers for the summer after my junior year, the traditional summer for journalism internships. I was rejected by all of them. So I worked instead that summer as a freelancer for the *Ann Arbor News*, covering school board meetings, zoning meetings, very basic stuff. Then, I applied to smaller newspapers than the ones that had rejected me, and I was accepted by a newspaper in

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Johnstown, Pennsylvania. I put off beginning my senior year and spent three months working there for free.

I held another internship at the *Des Moines Register* the summer after my senior year. And I interrupted my graduate work to intern at *Chicago Magazine*. Finally, after completing graduate school, I interned one last time at the *Detroit Free Press*, my hometown newspaper. I had wanted to work there since I was sixteen, and I knew that I would not be offered a professional job at such a big paper at the beginning of my career.

Where did you end up working at your first real job as a reporter?

I covered the police and schools beats at a small bureau of the *Charlotte Observer* in North Carolina. After a year and a half, I moved to Raleigh and became a feature writer for the *News and Observer*. I liked it there very much, but after two years I felt that my work wasn't improving. I wanted to go to a bigger city and work on a paper where I would get more editing. So I sent out lots of letters accompanied by writing samples, and eventually I was hired by the Baltimore *Sun*.

How do you market yourself as a writer?

You put together a package of clippings, say eight stories, that show your best work and the range of pieces you are able to write. Then, along with your résumé, you send a cover letter to the editor. I use that letter to explain how I'm distinctive as a writer, how what I can do is different from what other writers do. Specifically, what I say is that I write human interest stories that make readers feel something.

You seem to have been extraordinarily dedicated to your goal of becoming a successful feature writer.

I'm not sure if the steps I have taken were extraordinary; at the *Sun*, for example, there are interns who have held even more internships than I did. However, I have made every effort to advance as a writer and to position myself well in my career.

When I look back at the decisions I made, I don't feel much regret. I have enjoyed myself greatly. Even the demanding aspects of my training, such as moving so much to different areas, brought great advantages—the chance to see the country, the opportunity to live in big cities and small towns, and plenty of experience in how to fit in comfortably in different situations. In addition, I met all kinds of interesting people whom I wouldn't have met otherwise.

I do regret, though, that I haven't traveled outside the United States. I could have worked that in between college and graduate school, but I decided to continue freelancing instead. I was so aware of how competitive the field was. Now, I think that I could have made excellent use of a travel experience. You just have to be able to make the case that your less career-driven experiences contribute to who you are and what you are able to write.

Is it possible to break into journalism without starting as early as you did?

Sure. Not every successful journalist gets started at sixteen. Many of my successful friends came to journalism from other fields.

Whether you are sixteen or much older, what you need is your first opportunity, that first time someone takes a chance on you. And you can find that. I believe that if I walked into the *Ann Arbor News* today, at 28, with no journalistic experience, I could persuade someone to give me freelance work that would get the ball rolling for me.

Are there any pitfalls in the life you have chosen?

One potential pitfall is the strong culture of the journalistic world, the ease with which you can build your life around the newsroom. If all your friends are journalists, you can shut yourself off from alternative ways of thinking, alternative ways of seeing. That can be very bad for your work.

Relatedly, if you approach everything you are exposed to from the perspective of a journalist you can definitely limit yourself as a human being. Living life entirely as an observer, an outsider looking for a story, can prevent you from being able to get lost in something, from being able to get immersed. ■

Everywhere the older brother went, the younger brother followed.

John Drew Hirschbeck was born in 1984, Michael two years later; they were October babies with birthdays two weeks apart. They played video games and basketball and ran in the woods and rode bikes together. "If John was at our door, Michael was right behind him," said Joanie Ramson, whose son, Johnny, was the older brother's best friend. "I can remember Michael coming down the street with one training wheel on his bike, trying to keep up with them."

The Hirschbeck boys shared. They shared the love of their mother and father and younger sisters. They shared a big bedroom in a warm, tidy house in Poland, Ohio. They shared a mutated gene, passed silently from grandmother to mother to children, silently because it didn't kill girls, silently because it is so rare few people have ever heard of it. So difficult to say that it goes by initials: ALD.

"Adrenoleukodystrophy?" a librarian once asked Denise Hirschbeck. "You don't want to know about it."

—Excerpted from "The Umpire's Sons." The Baltimore Sun, *December 29, 1996*

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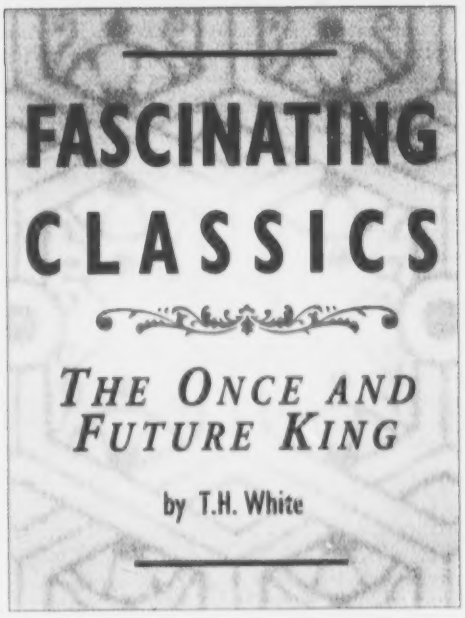
FASCINATING CLASSICS



Review by
Lesley Mackay & Michael Henry

Lesley: The legend of Camelot—of Merlyn, King Arthur, Queen Guenever, and the Knights of the Round Table—is one of the most familiar stories in Western culture. T.H. White's novel *The Once and Future King* reworks this tale in a rich and particularly modern way. The novel's first book, "The Sword in the Stone," is a fabulous description of the childhood of Wart, the future King Arthur. As a child, White's sweet and unpretentious protagonist is the penniless ward of an aristocratic family.

Wart receives a powerful education from his mentor, Merlyn, a magician who enjoys perfect knowledge of the future. Merlyn knows, but does not tell, that Wart will one day become king. To prepare Wart, the magician provides him with a series of magical experiences through which he becomes other life forms—a pike, a falcon, a badger. Merlyn gives Wart a unique opportunity to learn without losing his innocence.

Michael: With its focus on childhood innocence and fantastic transformation, the narrative and language of "The Sword in the Stone" are like those of a fairy tale. The story of Wart's childhood also contains elements of several myths—the creation myth, the legend of Robin Hood, and others.

It seems curious that White includes the story of Robin Hood in his retelling of the Arthurian legend—the tale of Robin Hood comes from a later era, that of Richard the Lionheart. However, "The Sword in the Stone" includes numerous anachronistic elements, such as references to psychoanalysis, Hollywood, and the plays of Shakespeare. These seemingly incongruous elements emphasize Merlyn's unusual relationship with time. He lives from the future, backward, which gives him a detached perspective on the present. Merlyn tries to pass on this detachment to Wart.

Lesley: Despite Merlyn's serious approach to tutoring Wart, "The Sword in the Stone" often has a lighthearted, even comical, texture. Here White depicts Merlyn trying to temper Wart's eagerness to undergo transformation:

> *Merlyn put down his knitting and looked at his pupil over the top of his spectacles. "My boy," he said, "you shall be everything in the world, animal, vegetable, mineral, protista, or virus, for all I care—before I have done with you—but you will have to trust to my superior backsight. The time is not yet ripe for you to be a hawk . . . so you may as well sit down for the moment and learn to be a human being."*
>
> *"Very well," said the Wart, "if that's a go." And he sat down.*
>
> *After several minutes he said, "Is one allowed to speak as a human being, or does the thing about being seen and not heard have to apply?"*
>
> *"Everyone can speak."*
>
> *"That's good, because I wanted to mention that you have been knitting your beard into the night-cap for three rows now."*

Michael: This whimsical tone all but disappears from the novel in the later books. White's almost jarring transition into the life of King Arthur illustrates the great divide between childhood and adulthood.

At the end of the first book, Wart pulls Excalibur from the stone and undergoes his final transformation, becoming King Arthur. In the second book he begins the struggle to maintain his innocence. The young Arthur is unaware that he was conceived in an act of violence and that he already has enemies. He is the son of Uther Pendragon, who raped his mother, Queen Igraine.

In the second book, Arthur unwittingly lets himself be seduced by one of Queen Igraine's daughters, his half-sister, Queen Morgause. Morgause in turn gives birth to Mordred. Filled with foreboding about the consequences of this liaison, Arthur commits a murderous act, ordering the deaths of hundreds of babies in a vain attempt to get rid of his illegitimate son.

Lesley: And so in the second book we learn that Arthur has always been subject to the darkest of forces and that, in his ignorance of his family history, he has extended the reach of evil into the present and the future. White's retrospective elaboration on "The Sword in the Stone" amounts to an ironic commentary on the blissful innocence that book depicts.

Michael: Exactly. The violence in which Arthur was conceived reemerges, and even Merlyn is curiously unable to protect him. Yet

World War II and T. H. White

by Michael Henry

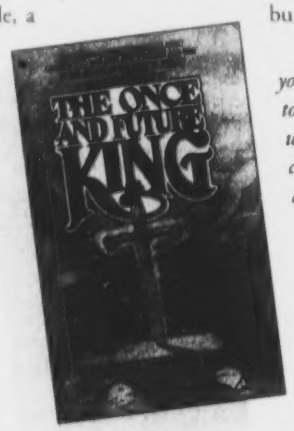
What makes T.H. White's *The Once and Future King* a classic? The Arthurian legend had already appeared many times in anonymous medieval texts such as *Sir Gawain and the Green Knight*, in Sir Thomas Malory's celebrated *Morte d'Arthur*, and in various works by authors such as Milton, Swift, Wordsworth, Tennyson, Emerson, and Twain. White's re-creation is unique, however, in its profound examination of humankind's propensity for hatred, violence, and warfare.

The novel was written between 1938 and 1941, during the early years of World War II in Europe. White was terrified by the war yet in conflict over whether to fight for England or to flee into exile. In February 1939, with money from the publication of "The Sword in the Stone," he and David Garnett, a painter from London's Bloomsbury group, went on what was initially a fishing excursion in Ireland.

His confusion about whether or not to fight in the war is beautifully described in his diary entry dated April 26, 1939: "Hawks neither band themselves together in war, nor yet retire from the world of air." Days later, he wrote in a letter to Sydney Cockerell, "I have made up my mind about this war at last. I am not going to fight in it. My most important business is to finish my version of Malory."

the theme of innocence remains at the heart of *The Once and Future King*. As ruler, Arthur tries to convert his innocence into an idealism powerful enough to transform his kingdom.

Lesley: Anyone familiar with the Arthurian legend knows that Arthur's aspirations are only briefly fulfilled. However, White movingly portrays the nobility of this great ruler. Arthur hopes to establish the rule of right over might, to destroy the threats posed by barbaric forces. To that end, he establishes the Round Table, a forum for negotiation among the leading knights.



Michael: White's portrait of Arthur as both a person and a king is rich in psychological depth. While Arthur's idealism does inspire social transformation, it also renders him unable to acknowledge the impure forces at work in himself and in those closest to him. He downplays his guilt in his liaison with Morgause and subsequent infanticide, and he avoids seeing the dark side of his Queen, Guenever, and his best friend and knight, Lancelot. This blindness compromises the effectiveness of his rule, endangering himself and his kingdom.

White comments frequently on the fragility of Arthur's forged peace. As his idealism is founded on innocence, the king cannot afford to throw stones in the glass house that Camelot becomes.

Lesley: It's interesting, Mike—we read the novel quite differently. While you emphasize Arthur as the cause of his own undoing, I see him as being undone by others. Arthur is a visionary, a morally ambitious ruler who is literally ahead of his time. His courageous attempt to make his society more civilized was always likely to fail, but he succeeds in introducing the powerful idea that right is superior to might.

Michael: I do admire Arthur, but his very innocence is a tragic flaw. White points this out at the end of his second book: "it seems, in tragedy, that innocence is not enough." Not only does Arthur let Morgause use him, but he also dismisses the threat posed by her sons, Mordred and the other members of the Orkney faction. This band of brothers suffers from an over-developed Oedipus complex. Due to their attachment to their mother, they kill rival men and ironically end up murdering Morgause, as well. Eventually, Mordred attempts to destroy Arthur, his king and father, fulfilling the Oedipal myth.

Lesley: Similarly, Arthur cannot confront the long-term love affair between Guenever and Sir Lancelot, one of the most fascinating characters in literature. Lancelot lives with a painful desire to transcend earthly experience by performing superhuman deeds such as fulfilling knightly quests and bringing about miracles. However, while he is idealistic to the point of madness, he engages in morally dubious activities. He corrupts his distinguished career as a knight by operating as a brutal henchman who destroys Arthur's foes, and he conducts a treasonous, adulterous love affair.

Lancelot's great love, Queen Guenever, the novel's most pragmatic and selfish character, rebels against the high-mindedness of both her husband and her lover, as she expresses in this outburst to Lancelot:

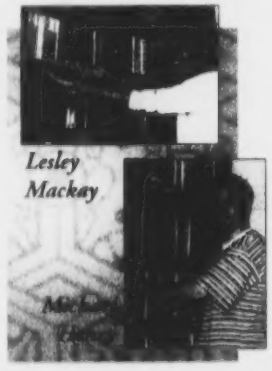
> *"Why can't we leave everything alone, and let your famous God look after it? It is no good trying to think, or do anything because it is right or wrong. I don't know what is right or wrong. But can't we trust ourselves, and do what does itself, and hope for the best?"*

Here, Guenever expresses passivity and nihilism that strongly contrast with the novel's dominant spirit of moral quest.

Michael: White does a wonderful job of calling attention to Guenever's striking humanity. Despite her beauty and dignity, she is not an archetype. In an interesting intrusion into the narrative, White elaborates:

> *One explanation of Guenever, for what it is worth, is that she was what they used to call a "real" person. She was not the kind who can be fitted away safely under some label or other, as "loyal" or "disloyal" or "self-sacrificing" or "jealous." Sometimes she was loyal and sometimes she was disloyal. She behaved like herself .... It is difficult to write about a real person.*

This passage reflects White's self-conscious presence in his novel. His many intrusions call attention to his role as author, to the writing process, and, often, to the twentieth-century perspective from which he writes. Like Merlyn, White comes out of the future; he moves backward through time to give his story a conventional chronology. Yet his novel ends with an emphasis on the future, with Arthur passing on to a young boy the ideal of non-violence—the true legacy of Camelot, the culmination of the king's long education. ■



Lesley Mackay

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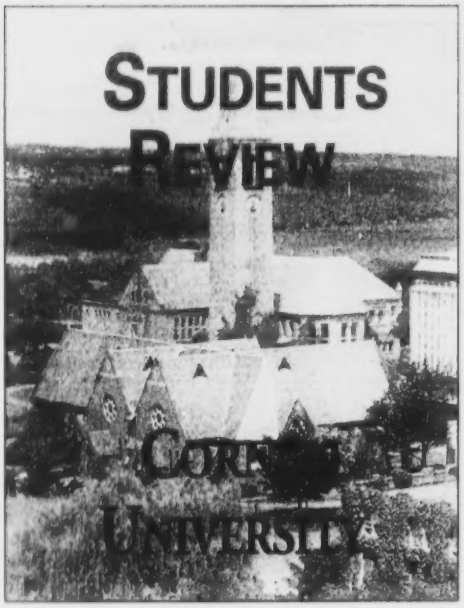
White remained in self-imposed exile in Ireland for six-and-a-half years. Nevertheless, he listened to news of the war on the wireless, describing what he heard as "more terrible than anything I can imagine as mere death." It was in this dark environment that he wrote the other three books of *The Once and Future King*.

White completed his great portrait of an idealistic ruler during one of the most hate-filled eras of history. Yet hope remains strong in the novel. White admitted that the first book, "The Sword in the Stone," was "more or less a kind of wish-fulfillment of the things I should like to have happened to me when I was a boy." And both the title and Merlyn's appearance at the end of the novel indicate a return to hope and a commitment to a better world.

Upcoming Fascinating Classics:

Willa Cather, *My Antonia*
John Steinbeck, *The Grapes of Wrath*
Virginia Woolf, *To the Lighthouse*
Ernest Hemingway, *The Old Man and the Sea*

STUDENTS REVIEW



The College Review Series is intended to aid prospective college students in their search by offering insiders' views of selected colleges and universities, as expressed by current undergraduates or recent graduates who have high academic ability. Note that the number of reviewers is small. Consider their personal perspectives as only one component while you gather relevant information from many sources.

Our reviewers include seventeen students, who major(ed) in biological engineering (1), biology & society (3), chemistry (1), computer science (1), ecology & evolutionary biology (1), engineering physics (1), English (1), geology (1), history (1), human development (1), math (1), mechanical engineering (1), physics (2), psychology (2), and sociology (1). (The number of majors exceeds seventeen because two reviewers completed double majors.)

Quality of Academic Instruction for Undergraduates

A unique combination of public and private institutions, Cornell was founded as a public, land-grant university but also houses several private schools, including an Ivy League College of Arts & Sciences. Reviewers agree that Cornell has *a lot* to offer if you choose carefully. With seven undergraduate schools—including Architecture, Engineering, Human Ecology, and Industrial & Labor Relations—Cornell offers a range of undergraduate programs hard to match at any other private institution. Each school has its own admissions requirements and core curriculum, but students may take courses at the other schools.

"In general, Cornell offers excellent instruction for undergraduates, although my experiences varied a great deal. Many freshman courses are taught as huge (500+ students) lectures, which are then broken down into small groups for recitation sections or labs. In large classes, getting to know the professor was not easy but was usually possible. As I began taking more specialized courses, classes became smaller and more comfortable. Many professors are very interested in students' career plans, projects, and opinions about particular courses."

"The variety of courses available is amazing. An engineering major, I've taken courses in Japanese, German literature, Indonesian music, and science illustration. The core curricula tend to be quite flexible, even in engineering. The facilities and the dozen or so libraries can't be beat. Many organizations provide tutoring; you can always find help if you need it."

"Perhaps Cornell's best feature academically is that it has so many very strong departments. Some intro-level classes are taught by some of the best professors at the university. That means you don't have to major in a field to learn from its best teachers; you just have to do a certain amount of sleuthing to find out who they are and what courses they're teaching."

"As with much at Cornell, everything depends on your school and major. It takes real commitment to major in many of the departments—to get through some of the more frustrating, 'weed out' courses. Overall, I've found the quality of instruction to be very high, but more times than I care to count I've had teachers who, while brilliant and widely recognized in their fields, couldn't teach their way out of a wet paper bag."

"Instructor quality varied tremendously. All my instructors were very knowledgeable in their fields, but many were poor teachers, some because of language difficulties, others because they approached their subjects as they would with professional colleagues rather than adopting a pace and vocabulary appropriate for first-time learners. However, by asking around and sampling classes, you can find creative, effective, fun instructors in nearly every department. It just takes a little investigation and the willingness to drop classes with poor instructors."

"You have to work hard, but by the time a course is over, you really feel you've learned something. Grades mean something here; As are given only to people who really work for them."

Social Life

A school this large has something for everyone.

"The location is beautiful—on a hill overlooking a lake, with forests, botanical gardens, and a gorge with a waterfall (yes!) on campus. It's really a very picturesque setting, and the surrounding area is great for outdoor activities. A nearly infinite number of clubs and extracurriculars exist, although you have to choose carefully—the course load doesn't offer much free time. But even with heavy course loads, Cornell students find time to be activists about nearly everything imaginable."

"Cornell offers everything from raging Greek parties to the many clubs to quiet time. The dorms each have their own personality and social opportunities. West Campus dorms have more of a party atmosphere, while North Campus dorms are quieter. Many sophomores and juniors involved in the Greek system live in a frat/sorority house, while most seniors live in Collegetown, a nearby commercial district with bars, coffee shops, a performing arts center, restaurants, and stores."

"The specialty dorms play a huge role in campus culture. Risley Hall, the creative arts dorm, has a theater, a recording studio, a darkroom, a print shop, a jewelry and stained glass studio, a pottery shop, and a full calendar of cultural programs. In addition, each semester two guest artists are selected by the residents to live in the dorm and teach their crafts. The Music house puts on concerts regularly, while the Ecology House seems to perform endless community service functions. Other houses celebrate African-American, Latin American, and Indian-American cultures."

"I liked the social life a lot. It's a big school, of course, but if you have a good dorm, that's not a problem. The SLU (Scholarly Living Unit) floors are a great place to live first year—really nice people, not quite so much drinking, and not really that geeky."

"Some people complain that Ithaca has a lame night life and is miles from anywhere interesting, but I enjoy Cornell's multicultural community in a small city setting. The Greek system plays an important role in the social life,

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but those of us who have decided not to get involved still have lots to do. With hundreds of extracurricular organizations, dozens of intramural sports, and thousands of other students, anyone who is bored just isn't trying very hard."

What Do You Like Best about Cornell?

The vast resources and the beautiful surroundings were most often singled out for praise.

"The choices, the opportunities, the variety. There's so much to choose from—in your major, your courses, your spare time, and your part-time job. The down side of having so many options is that you may get off track, but I think it's worth the risk. And the people here are really cool. You can easily find a niche."

"The campus is beautiful, as I often remind myself when stressed out about exams. Resources are unbelievable, if you know where to find them: Cornell has everything from an original Lindisfarne Bible to its own nuclear reactor."

"First, the campus is far and away the most beautiful college campus I've ever seen. The gorges are breathtaking, the lake is beautiful, and there are miles of jogging trails through the woods. To find a place as beautiful as the Cornell campus, you'd be better off looking among national parks than among other universities. Second, the students are good people. Most have an excellent work ethic and are genuinely interested in learning, not just in their GPAs."

"Professors will often go out of their way to get bright, interested students involved in research. I'm working with someone who helped me design my own project, gave me a lab in which to carry out my experiments, and helped me successfully apply for a grant to support my work."

What Do You Like Least about Cornell?

Not much disagreement here: the winters.

*"It's **cold**! Ithaca weather bites! Summer is beautiful and so is fall, but winter is miserable and spring doesn't come until finals week."*

"The weather in Ithaca is pretty horrible. The joke at Cornell is that Ezra Cornell told his friends he would found an institution 'where any student can receive instruction in any study,' and that he would put it in a beautiful natural setting. His friends said, 'That's the perfect university—you'll have people practically beating down the doors to attend!' So Ezra said, 'Ah, but wait until you see where I put it ....'"

*"Not seeing the sun for weeks at a time is a **serious** drawback. Depression is common at Cornell, and I believe the weather is a major reason. It's insidious; people often don't realize that the reason they're miserable is that the weather around them is miserable."*

Cornell University

Ithaca, NY 14850
(607) 255-5242

- 4-year public *and* private coed university.
- 740-acre campus in upstate New York, on a hill overlooking 43,000-acre Lake Cayuga.
- Full-time undergraduate enrollment 1996–97: 7,118 men; 6,394 women.
- Special features: Cornell's private colleges include Arts & Sciences, Architecture, and Engineering. State-supported colleges include Agriculture & Life Sciences, Human Ecology, and Industrial & Labor Relations. Cornell owns 3,000 acres of botanical gardens, arboretum, nature preserves, and trails.

"The size and impersonality. Class sizes are often in the hundreds, even for upperclassmen. The stress level gets pretty high, and big classes that grade on a curve don't help. While I've never personally experienced competitive behavior from other students (not sharing notes or old tests), I hate knowing that I have to do better than a certain percentage of my classmates to get a decent grade. Despite this stress, students often work together in study groups, and coping with the workload fosters friendships."

Who Would Be Most Compatible with the Academic and Social Atmosphere at Cornell?

Students able to chart their own course through Cornell's vast sea of offerings may fare best.

"It takes a fair amount of independence, self-confidence, and organization to succeed. You have to be able to decide on your academic program on your own; I didn't get much advising."

"Most anyone who gets in can feel at home. For most of us, the hardest part is staying on track. If you don't have a focus, classes just become something you have to fight the cold to go to. I know—I was like that for two years. But once you find your focus, everything falls into place."

*"If you are intelligent and curious, enjoy diversity in both academics and people, and don't mind snow—**in April**—Cornell could be a good choice for you. If big-city excitement is necessary for your happiness, or if you feel strongly that large lecture classes are not a good learning environment, maybe it isn't. But come look us over. The campus is beautiful, with an incredible mishmash of architectural styles."*

If You Had It to Do Over Again, Would You Go to Cornell?

All but two reviewers said yes, a few with mixed feelings.

*"Absolutely. I am doubtful whether any other university in America could offer me an undergraduate experience that measures up to the one I had at Cornell. So what if it snowed during Easter, Mother's Day, and finals last year—I love snow. The people are great and the academics are **definitely** challenging."*

"Yes and no. I'd choose Cornell, but I'd have them put it in a warmer location!"

"No. I'd choose a smaller school where I could receive personalized academic advising. I entered college with many interests that I wanted to explore and possibilities I wanted to consider, and found I had to do it all on my own. To succeed academically at Cornell, you must be very clear about what you want from your college education."

As you try to find the college or university best suited to you, the views presented above may be helpful. Keep in mind that these students might have had similar positive or negative experiences had they attended a different school. At any college, it is important to seek out challenging academic experiences and to create a social life that fits your personal style. ■

Note: The students quoted in the College Review Series are expressing their own views, which are not necessarily those of HFU or IAA.

29 BEST COPY AVAILABLE

PLANNING AHEAD FOR COLLEGE

Is Medical School in your Future?

Consider Combined College/Medical School Programs

by Linda E. Brody, Ed.D.

An increasing number of medical schools now offer combined college and medical school programs—either with their own undergraduate institution or in collaboration with other undergraduate institutions. These programs admit highly qualified high school seniors with a strong desire to pursue medicine as a career. Participants receive a bachelor's degree from the college or university and an M.D. from the medical school. Combined programs virtually guarantee your acceptance into the medical school portion of the program, provided you meet certain requirements.

Knowing that there is a guaranteed place for you in medical school takes a lot of the pressure of college off your back.
—Student at Northwestern

The duration, content, and specific requirements of these programs vary considerably. If you're thinking about applying to combined college/medical school programs, research them carefully, giving special consideration to the type of undergraduate education you are seeking.

Combined programs range from six to eight years in length. Students usually take undergraduate courses during the first two to four years and enroll in medical school during the final four years. Eight-year programs generally allow students to enjoy a full undergraduate experience, while students in six- or seven-year programs face limitations in the courses they can take as undergraduates. Regardless of the duration, many combined programs also offer students unique opportunities to learn about medical careers, as well as reduced anxiety over getting into medical school.

As a Program in Liberal Medical Education (PLME) student, I've spent days with an emergency room physician and a neonatologist at Brown-affiliated hospitals, and attended lectures about special topics such as women in surgery. I am a neuroscience concentrator, but PLME students are encouraged to major in whatever subject interests them most, not just science.
—Student in the 8-year program at Brown University

I will be in medical school for a very long time and saving a year now will be nice in the long run.
—Student in the 7-year program at Northwestern

Many combined programs also permit you to apply to other medical schools, so you're not necessarily limited in your choice. Of course, applying to other medical schools will put you under the same pressure to achieve high grades and good MCAT scores that you would experience if you weren't in a combined program. Even within the combined programs, academic standards regulate advancement from the undergraduate to the medical school portion of the program, so you will still want to do your best.

You can't take the range of courses you could in a four-year program. My program requires you to major in biology, which I probably wouldn't if I didn't have to.
—Student in the 7-year program at Trenton State and New Jersey Medical School

These programs are not for everyone, but if you know medical school is in your future, you may find many advantages in enrolling in a combined college/medical school program. Consider the list that follows and contact the institutions directly for more information. ■

Inteflex offers a sense of community. There are two counselors who know you by name before you arrive; the two directors and several teachers connected with the program also get to know you. They organize many activities and really take care of you.
—Student at University of Michigan

U.S. Medical Schools and Colleges Offering Combined Programs*

Albany Medical College with Rensselaer Polytechnic Institute, Siena College, or Union College
Baylor College of Medicine with Rice University
Boston University
Brown University
Case Western Reserve University
Chicago Medical School with Illinois Institute of Technology
East Tennessee State University
Eastern Virginia Medical School with The College of William and Mary, Old Dominion University, Hampton University, and Norfolk State University
George Washington University
Howard University
Jefferson Medical College with Pennsylvania State University
MCP●Hahnemann School of Medicine with Lehigh University or Villanova University
Meharry Medical College with Fisk University
Miami University
Michigan State University
New York University
Northeastern Ohio Universities College of Medicine with Youngstown State University, Kent State University, or the University of Akron
Northwestern University
Sophie Davis School of Biomedical Education with City University of New York (in cooperation with seven New York medical schools)
SUNY Brooklyn College of Medicine with Brooklyn College
SUNY Syracuse College of Medicine with Binghamton University
UCLA College of Medicine with University of California-Los Angeles or University of California-Riverside
UMDNJ-New Jersey Medical School with Boston University, Drew University, Montclair State University, New Jersey Institute of Technology, Stevens Institute of Technology, The Richard Stockton College of New Jersey, or Trenton State College
University of Michigan
University of Missouri-Kansas City
University of Rochester
University of South Alabama
University of Southern California
University of Wisconsin

*This list is limited to institutions that admit students directly from high school. Institutions that select students for special programs and/or accelerative opportunities later in the program are not included. Some programs are limited to state residents. For more information, visit the Web site of the Association of American Medical Colleges at www.aamc.org

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THE COACH'S CORNER

by Chengde Feng

Mr. Feng teaches mathematics at the Oklahoma School of Science and Mathematics (OSSM) and has coached many students who have competed successfully in mathematics contests in China and the U.S. In this column, Mr. Feng offers Imagine readers questions designed to improve their problem-solving skills.

1. Let f be a function such that for all integers m, n
(i) f(m) is an integer
(ii) f(2) = 2
(iii) f(mn) = f(m)f(n)
(iv) f(m) > f(n) when m > n.
Find the value of f(3).

2. Given a function satisfying $f(x) + 2f(\frac{1}{1-x}) = x$, find f(2). (MAΘ 1992)

3. Let $x = \frac{\sqrt{n+1}-\sqrt{n}}{\sqrt{n+1}+\sqrt{n}}$ and $y = \frac{\sqrt{n+1}+\sqrt{n}}{\sqrt{n+1}-\sqrt{n}}$ where n is a positive integer.
Find n if $3x^2 - 25xy + 3y^2 = 1997$.

4. For arbitrary integers u and v, verify that if $u^2 + uv + v^2$ is divisible by 9, denoted by $9 \mid u^2 + uv + v^2$, then u and v are both divisible by 3, i.e., $3 \mid u$, and $3 \mid v$.

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SCHRÖDINGER'S PEN

by Yoon Ha Lee

Doubtless there are many possible ways to kill a cat. Schrödinger's thought experiment, however, must be one of the more unorthodox. The unfortunate feline is sealed in a box, then trapped between life and death by the nature of quantum indeterminacy until an observer opens the box, collapsing the function, and discovers either a living cat or a corpse.

Now consider the real-world applications of Schrödinger's Cat:

My younger sister Yune nudges open the door to my room and peers in. Not for the first time, she asks, "Can I borrow a book?"

There are two possible outcomes. Either I nod grudgingly and wave her toward the overpopulated bookcases along the wall, or I snarl, "Get out!" and hurl a ballpoint pen at her to expedite her departure. Imagine that my room is sealed, so an outside observer has no way of telling which outcome is chosen. From the observer's point of view, Yune is in a state of flux, her request neither granted nor rejected, until she leaves the room with her prize or empty-handed. The situation inside my room, of course, is another story.

I have yet to chat with a sea-dragon from the rail of a ship that rides the wind, or to send a starship dancing to the distant voices of stars and away from an enemy's whirling attacks, yet I have written about both.

The problem with the above, aside from a certain older sister's fondness for projectiles, is that the outcome is hardly based on a well-defined quantum state. As Yune has often complained, "Every time you're in a bad mood, you throw a pen at me!" Usually I can justify myself by warning her that I am attacking a recalcitrant physics assignment. During the summer, unfortunately, that excuse fails.

Instead, I must give Yune another reason. Working on a three-page history paper is headache enough. Working on a full-length novel, on the other hand, can sometimes be described as terminal agony, cause enough for a "bad mood." No one requires me to write during the summer or in my spare time, but that is little consolation when I spend half an hour searching for the "right word" despite the universal advice to finish the first draft and worry about details later.

For me, writing is an addiction. I cannot surrender to writer's block or the endless distraction of other responsibilities. Why remain chained to this world when I can explore mist-shrouded citadels or the glitter of distant galaxies?

"Write what you know," they say. "They" might as well ask an observer to determine whether Schrödinger's cat is alive or dead without opening the box. I have yet to chat with a sea-dragon from the rail of a ship that rides the wind, or to send a starship dancing to the distant voices of stars and away from an enemy's whirling attacks, yet I have written about both.

These are realms that lack even the puzzling existence of quantum possibilities. Let me collapse the function so these realms live on paper rather than in the flux of my mind ... even if my sister must perfect the art of dodging ballpoint pens.

Yoon Ha Lee *is now in her first year at Cornell University. In addition to writing, she is interested in physics, music, history, and computer science.*

YOUR WRITING COULD BE ON THIS PAGE!

We welcome submissions of poetry, short stories, essays, book reviews, and puzzles.

Please write to *Imagine* • SET at IAAY • The Johns Hopkins University • Baltimore, MD 21218

MARK YOUR CALENDAR...

with these September–November registration deadlines for selected academic competitions. Inquire about competition format, dates, and fees.

DEADLINE	COMPETITION
September	**United States Academic Decathlon**—Schools register teams, grades 9-12; state deadlines vary: P.O. Box 5547, Buena Park, CA 90622; (714) 522-8723.
October	**Future Problem Solving Program**—Schools register teams, grades 7-12; ask about state affiliates: 318 W. Ann Street, Ann Arbor, MI 48104-1337; (313) 973-8781; (800) 256-1499; www.fpsp.org/
October 15	**Mandelbrot Competition**—Schools register, grades 9-12; request invitation letter by September 15: Sandor Lehoczky, Greater Testing Concepts, P.O. Box 5014, New York, NY 10185-5014; (708) 795-7865; sandor@interaccess.com
October 15	**National Geography Bee**—Principals register schools, grades 4-8: National Geographic Society, 1145 17th Street, NW, Washington, DC 20036-4688; (202) 828-6659; www.nationalgeographic.com/society/ngo/geobee/
October 15 or November 1	**American Junior High School Mathematics Exam (AJHSME)**—Schools register, up to grade 8; lower fee for earlier date: Dr. Walter E. Mientka, American Mathematics Competitions, Department of Mathematics and Statistics, University of Nebraska, P.O. Box 81606, Lincoln, NE 68588-0658; (402) 472-2257, (800) 527-3690; fax (402) 472-6087; www.unl.edu/amc/
November	**MATHCOUNTS**—Schools register teams, grades 7-8: MATHCOUNTS Registration, P.O. Box 441, Annapolis Junction, MD 20701; (301) 498-6141. All other questions: MATHCOUNTS Foundation, National Society of Professional Engineers, 1420 King Street, Alexandria, VA 22314-2794; (703) 684-2828; mathcounts.org
November 15	**U.S. Senate Youth Program**—Each state nominates two delegates and alternates in grades 11-12 who are elected student leaders: Ask your high school principal, chief state school officer, or office of DoD Dependents Schools.
mid-November	**National German Test**—German teachers register, German II-IV: American Association of Teachers of German, 112 Haddontowne Ct. #104, Cherry Hill, NJ 08034; (609) 795-5553, fax (609) 795-9398.

DEADLINE	COMPETITION
November 21	**Knowledge Master Open**—Schools enter one team per division (middle, junior high, high school): Academic Hallmarks, Box 998, Durango, CO 81302; (800) 321-9218.
November 24	**Westinghouse Science Talent Search**—Students enter individual original projects, grade 12 only: Science Service, Inc., 1719 N Street, NW, Washington, DC 20036; (202) 785-2255.
Other:	**National Spelling Bee**—Scripps Howard, Inc.: Students enter only through a sponsoring newspaper; ask your local press if they participate, or find your local sponsor at www.spellingbee.com/particip.htm

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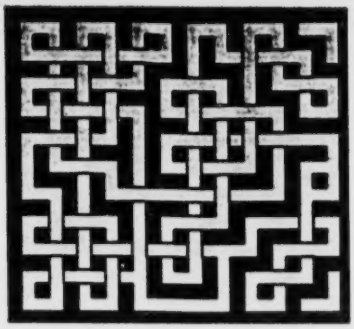


Knossos Games

by Tim Boester

*Fascinated by mazes and puzzles, **Tim Boester** is also intrigued by roller coaster design. Tim is a senior at the University of Chicago, where he is studying math.*

Not everyone would find the inspiration for a puzzle in Biology 101, but then, that's why Tim is a puzzlemeister. Here are stratified squamous epithelial cells as you've never seen them before.

The Goal: By moving the asterisk around the epithelial cells, maneuver all the filled green circles into cells with vacuoles (open green circles).

The Rules: You control the asterisk. The only way to move within this cellular maze is via the facilitated transport systems (arrows). Like their real-life counterparts, these transporters facilitate movement of substances according to certain rules:

→ ***Uniport*** systems allow one-way movement only. In the puzzle, uniporters serve as one-way doors for the asterisk.

⇉ ***Symport*** systems allow a substance to pass only if accompanied by a partner. In the puzzle, you can move using a symporter only if a filled circle moves *with* you.

⇄ ***Antiport*** systems allow a substance to enter the cell only if another leaves. In the puzzle, you can move using an antiporter only if a filled circle moves *opposite* you.

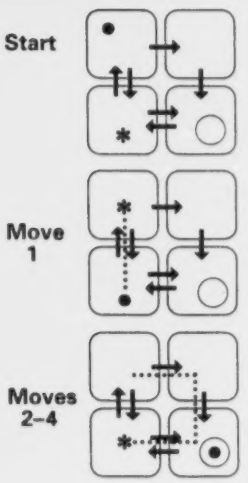
- The filled circles can only move in conjunction with the asterisk; they cannot move alone.
- Only the asterisk and filled circles move from cell to cell; the vacuoles do not move.
- Some filled circles are already in cells with vacuoles, but you may need to move them in order to get the rest of the filled circles into cells with vacuoles.

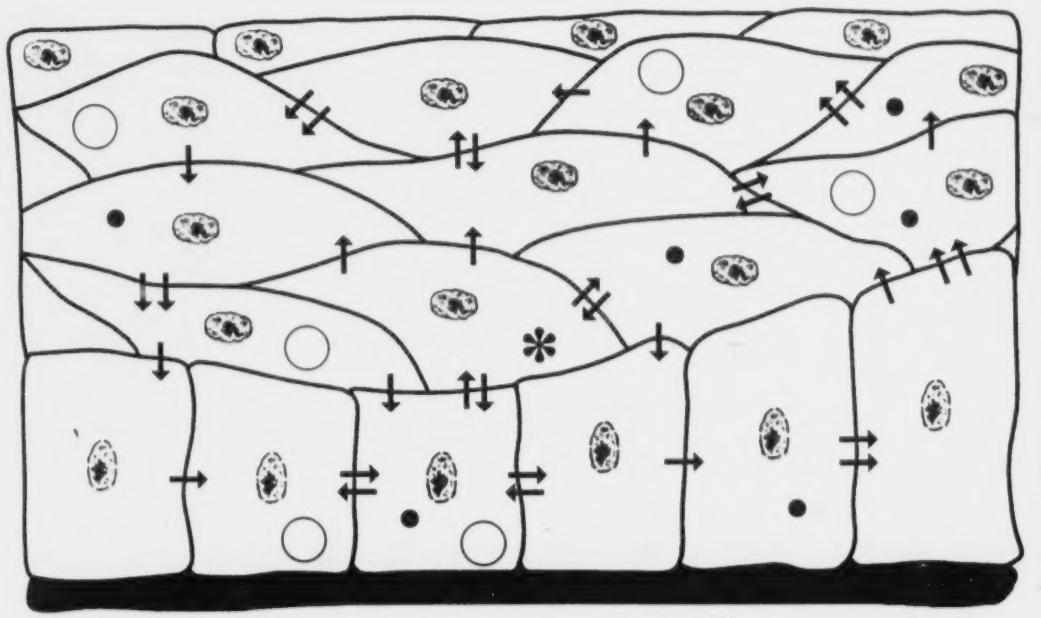
You have completed the puzzle when all the filled circles are in cells with vacuoles.

The example shows an asterisk maneuvering a filled circle into a vacuole in four moves.

You can practice on simpler puzzles like this at http://student-www.uchicago.edu/users/tcboeste/

EXAMPLE



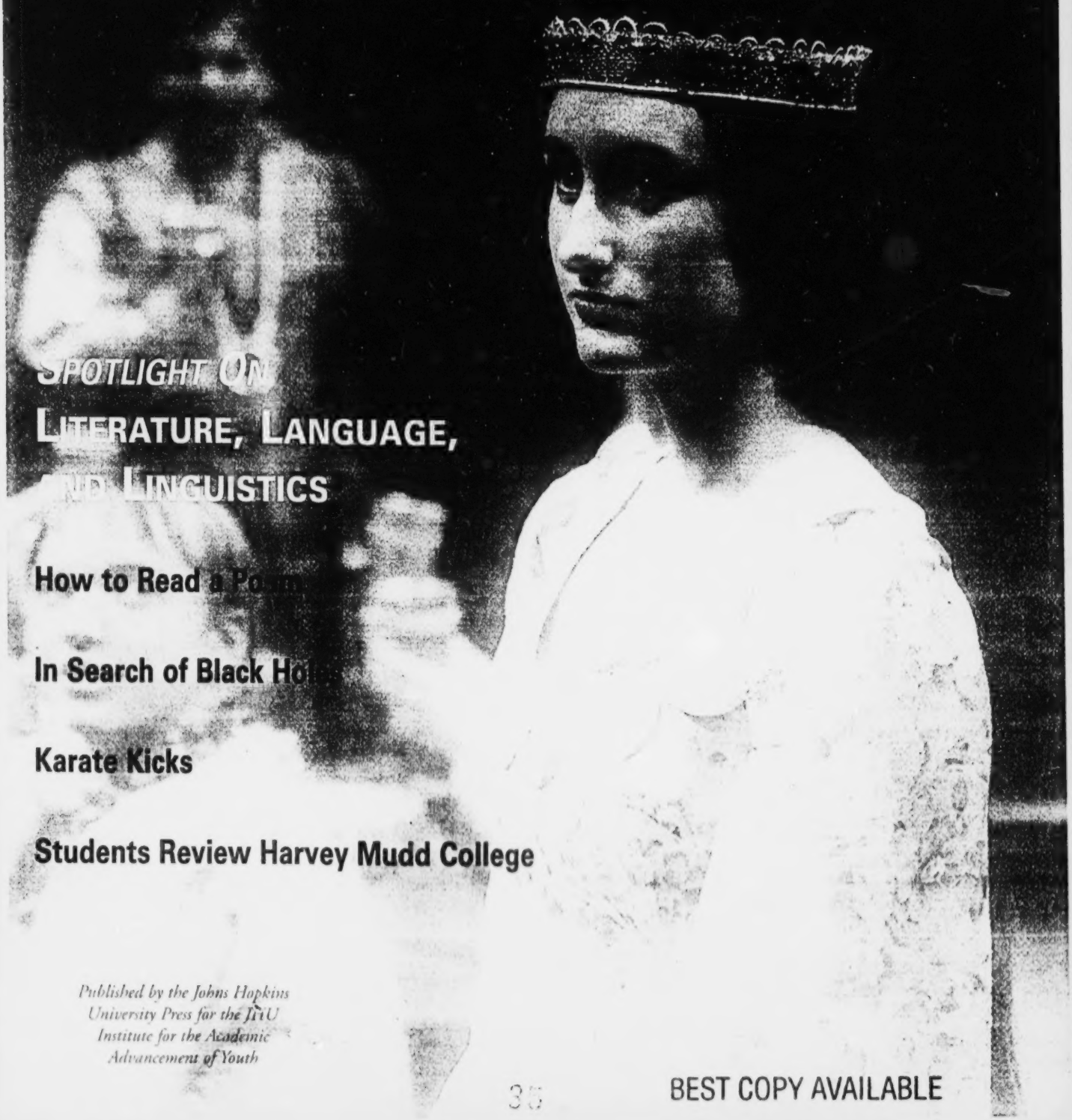


VOLUME 5 • NUMBER 2

ImaGiNe...

Opportunities and Resources for Academically Talented Youth

November/December 1997



SPOTLIGHT ON LITERATURE, LANGUAGE, AND LINGUISTICS

How to Read a Po

In Search of Black Ho

Karate Kicks

Students Review Harvey Mudd College

Published by the Johns Hopkins University Press for the JHU Institute for the Academic Advancement of Youth

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FROM THE EDITOR

Dear Reader,

In his essay "University Days," James Thurber relates that he could never pass botany because, despite the urgings of his professor, he could never see through the microscope:

> *"I can't see anything," I would say. He would begin patiently enough, explaining how anybody can see through a microscope, but he would always end up in a fury, claiming that I could* ***too*** *see through a microscope but just pretended that I couldn't. "It takes away from the beauty of flowers anyway," I used to tell him. "We are not concerned with beauty in this course," he would say. "We are concerned solely with what I may call the* ***mechanics*** *of flars."*

Although they were both interested in the flowers, Thurber cared more about aesthetics while his professor was more concerned with structure. But both ways of appreciating the flowers are valuable and significant.

Like Thurber's flowers, language can intrigue us in different ways. When we study literature, for example, we have several approaches from which to choose. We can consider a work in its historical context, learning more about the time period in which it was written to understand it more fully. Or we might learn more about the author to see if we find biographical elements in a text. We even have the option of not considering any information other than the words contained in the poem, story, or play itself. Each of these approaches can yield a significant reading—it's up to us to decide which will be the most meaningful and interesting.

Just as approaches to a literary work may vary, so may our individual responses to it. You and I might thoroughly enjoy reading the same story, but when asked why we enjoyed it, we would probably give different reasons. You might cite the strong characters or images or symbols, while I might say that I simply liked the writer's style or the surprise ending. We would respond to the text in ways as individual as we are, which is one of the greatest pleasures of reading and discussing literature. Unlike Thurber in his botany class, we could use both perspectives to gain a deeper appreciation of what we've read.

That is, of course, if we enjoy reading and discussing literature. For some students, the appeal of language lies not in how writers use it to create art ("the beauty of the flowers"), but in the science of language ("the mechanics"). Linguistics and its subfields offer a wide range of ways to study language in a scientific way. For example, syntacticians and phonologists analyze diverse languages to look for patterns in structures, while researchers in psycholinguistics investigate how our brains process language. And there's even a way to combine your interests in language and computers: natural language processing, which focuses on using computers to interpret human languages.

In this issue of *Imagine*, we explore a variety of ways to study—and be fascinated by—language. You'll discover how language has captivated our writers, from the underlying structures that govern languages, sentences, poems, and fairy tales to the artistic use and significance of individual words. So whether your interests include literature, computer science, or both, read on.

Melissa Hartman

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Imagine...
Opportunities and Resources for Academically Talented Youth™

ISSN 1071-605X
Volume 5 • Number 2
November/December 1997

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Published five times a year—September/October, November/December, January/February, March/April, and May/June.

Application to mail at Periodicals Postage Rates is approved at Baltimore, MD, and additional mailing offices.

POSTMASTER: Send address changes to *Imagine*, The Johns Hopkins University Press, Journals Publishing Division, P.O. Box 19966, Baltimore, MD 21211.

Imagine is published by the Johns Hopkins University Press for the Study of Exceptional Talent (SET) at the Johns Hopkins Institute for the Academic Advancement of Youth (IAAY). This publication is an outgrowth of newsletters and programs that, for twenty-five years, have served highly talented students identified by the Study of Mathematically Precocious Youth (SMPY) and by SET.

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Annual subscription: $30.00

Address subscription inquiries to:
Journals Publishing Division
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Baltimore, Maryland 21218-4363
(410) 516-6989 • fax: (410) 516-6968
toll-free: (800) 548-1784

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On the cover:
Caitlin McDonough-Thayer performs in an adaptation of Shakespeare's* Pericles *by David Montee. Photo by David Speckman, courtesy of Interlochen Center for the Arts.

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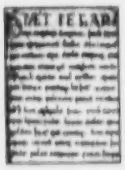
Contents

Focus On: Literature, Language, and Linguistics

The True Sense of a Word



What's in a word? Etymologies often reveal the poetry and fascinating stories behind words we use every day 4

The Buzz About the Bee: Winning the 1997 National Spelling Bee

From the months of early-morning studying to her winning word, Rebecca Sealfon describes how she became the 1997 Spelling Bee champion 6

The Intricacies of Translation and the Creative Role of the Translator

Is it possible to achieve an exact translation of a text? Or is something inevitably lost—or gained—in the process? 8

The Importance of Being Grammatical

What do people in glass jars have in common with gargantuan groundhogs? They're both the unintentional creations of poor grammar 10

From the Inside Out: How to Read a Poem

Whether you're reading poems for homework or for pleasure, here are some tips for getting the most out of your reading 12

A Notebook of Questions: A Summer Inquiry into Literature and Language

A philosophical question drew Katy Wischow to a summer program in language and literature. After six weeks, she found herself asking more questions than she started with 14

A Union of Body and Mind

Martial arts require not only physical dexterity, but also mental focus. Anisha Patel, a black belt, describes how karate has made her a stronger person on both levels 16

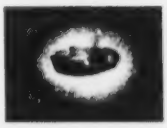
On Linguistics, Patterns, and Passing French

As linguists analyze the way people acquire, use, and process language, they're discovering some interesting patterns 18

Intelligent Computers, Propp-osed

You already know the tales of Little Red Riding Hood and Hansel and Gretel. Soon you could be adding computer-generated fairy tales to your list of familiar stories 19

Exploring Career Options: Astronomy



Interview with astronomer Luis Ho 21

Fascinating Classics

My Ántonia *is Willa Cather's novel about a young girl's coming-of-age on the Nebraskan plain* 24

Students Review Harvey Mudd College 26

Planning Ahead for College

Extracurricular activities allow you to extend your learning beyond the classroom—and to gain a competitive edge in the college admissions process 28

The Coach's Corner 29

Creative Minds Imagine

Remembering Miami *by Adrian Mall; a maze by Edward Shen* 30

Mark Your Calendar 31

Knossos Games 32

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The True Sense of a Word

by Melissa Hartman

The English language has a history full of heroism and tragedy, conflict and accommodation; it has been shaped by warriors, missionaries, scholars, and peasants. We draw from this history every day as we write and speak a language that has been evolving for more than 1,500 years. We use words centuries old without realizing it—but if we listen, these words have stories to tell.

Exploring etymologies—the origins and historical development of words—is the practice of listening to these stories. If you spend some time learning the history of words, you'll have a better understanding of the English language, you'll access new levels of meaning, and you'll improve both your reading and writing abilities along the way.

The Poetry of Origins

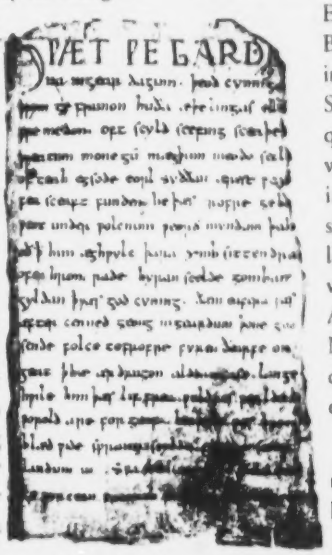
In *Nature*, Ralph Waldo Emerson observes, "as we go back in history, language becomes more picturesque, until its infancy, when it is all poetry." Etymologies reveal this poetry by taking us back through a word's history and often allowing us to see an original concreteness. Emerson points out, for example, that "*right* means *straight*; *wrong* means *twisted*."

Some words have origins that even sound like poetic expressions. For example, *squirrel* is from Greek roots that combine to mean *shadow-tail*. And *daisy* comes from an Old English compound word, *dægsage*, or *day's eye*. The word originally referred to a flower that closed its petals at night and opened them during the day, hiding and then revealing its figurative eye. Another flower, the dandelion, takes its name from the French *dent de lion*, or *lion's tooth*, a reference to the jagged, tooth-shaped leaves of the plant. All of these words have origins that are really metaphors, figures of speech that attempt to capture the essence of one thing by describing it in terms of something else.

The etymology of *bead* reveals another figure of speech, metonymy, in which we refer to one thing by the name of another thing commonly associated with it. *Bead* derives from *gebed*, the Old English word for *prayer*. As the medieval Christian practice of "telling one's beads"—using beads on a string to keep count of one's prayers—became common, the word for *prayer* came to refer to the beads themselves. *Gebed* eventually became *bede*, referring specifically to rosary beads, in Middle English. From there, the meaning extended to include other kinds of beads and even bead-like objects, such as a *bead of water*.

The Making of English

As you study etymologies, you'll discover that the words we use today have origins in many different languages. This diversity, which gives English its remarkably flexible and subtle powers of expression, evolved as the inhabitants of the British Isles came into contact, by force or by choice, with people who spoke other languages.



Excerpt from Beowulf, written c. 1000 A.D. Reprinted from "The Electronic Beowulf," edited by Kevin S. Kiernan

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Invaders from Denmark and Germany, called Angles, Saxons, and Jutes, brought their Germanic languages to the British Isles beginning in 449 AD. Later simply called Anglo-Saxons, they blended their languages into a mutually understandable one that we know as Old English. Over the next 150 years, as the Anglo-Saxons drove the native Britons and their Celtic languages west, they established a kingdom that roughly corresponds to modern-day England. Just as importantly, they set down the tenacious roots of language that survive in English to this day.

As England converted to Christianity, beginning with the arrival of St. Augustine and his monks in 597, about 400 Latin and Greek words entered Old English. With the capacity to express abstract thought, these words augmented the Anglo-Saxon vocabulary that was based so heavily in the physical world. The Old English vocabulary, which already included such words as *crop*, *field*, *plow*, and *rain*, grew to incorporate *angel*, *apostle*, *relic*, *martyr*, and other religious terms. The language now had words to describe both physical and spiritual experiences.

It wasn't until about 200 years later that English met the first threat to its survival. In 793, the Vikings began invading the British Isles; by 850 they controlled nearly half of Britain. But in 878, in a surprise attack mounted by King Alfred of Wessex, the Vikings were defeated. Although this defeat ensured that Norse would not replace English as the language of Britain, Old English did take in about 900 Norse words. Since the two languages were quite similar, many of these words were cognates (words in different languages that share the same root and similar meanings) of Anglo-Saxon words. For example, the Anglo-Saxon *scyrte* and the Norse *skyrta*, both of which originally meant *shirt*, coexisted in Old English.

Had the story ended there, today we might be speaking a language similar to modern Dutch. But in 1066, the year of the Norman Conquest, English was forever changed. The French-speaking conquerors took over the high positions in the government, the courts, and the churches. English was spoken only by the laboring class.

For generations after the Norman Conquest, language reflected this difference in class. But when the King of France forced the Norman nobles in England to choose between their properties in France and England in 1244, those who remained in England had a reason to learn its language. The Hundred Years War between England and France provided another reason to speak English rather than French, as did the

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speak English rather than French, as did the Black Death of 1349-50, which, by making labor scarce, improved the status of the English-speaking working class. English had survived.

But it had changed—dramatically. Some Latin and French words replaced Anglo-Saxon words; some cognates coexisted; and some compound words, such as *gentleman*, were created from French and Anglo-Saxon elements. The result of this blending was Middle English, a language that, unlike Old English, is intelligible to modern readers.

The Renaissance, with its emphasis on classical scholarship, brought even more Latin and Greek words into English. And when new words were needed for inventions and discoveries during the Industrial Revolution, many were created from Latin and Greek roots. Words from all over the world came into English with the growth of the British Empire, and even today, English is evolving with advances in technology and increased exposure to the rest of the world.

Getting Back to the Roots

As a reader, you may already be aware of the benefits of knowing etymologies. If you've ever taken a class in French, Spanish, or Italian, you've probably noticed the similarities between English and the Romance languages (languages that developed from Latin, named for their link with Rome). You may have even been able to figure out meanings of unfamiliar words in English by remembering similar words in another language. Because so many English words come from Latin and the Romance languages, you can enjoy the same benefit by learning etymologies. While you may initially spend a lot of time with the dictionary, you'll eventually spend less time looking up words and referring to footnotes for definitions.

You'll also find that your readings of texts will become much richer and more precise. Especially in texts more than a century old, etymologies are your link to a layer of original meaning, which context alone might not make clear. For example, when you read in Andrew Marvell's *To His Coy Mistress*, "My *vegetable* love should grow/ Vaster than empires, and more slow," you'll know that Marvell isn't referring to a garden but using *vegetable* in its original sense, as an adjective meaning alive, growing. Similarly, when Hamlet describes "an excellent play, well *digested* in the scenes," you'll know that he is praising the play for its order and arrangement, which you probably wouldn't realize if you relied on today's definition of the word.

Since a word's significance in context often lies somewhere between its original and modern definitions, knowing the original meaning helps us define a frame of reference. Of course, you'll still have to decide which meanings best apply in a given context, but you'll have the full range of possibilities to choose from.

As a writer, you can become more precise in your expression if you know etymologies. If you've ever used a thesaurus to help you avoid repetition in a paper for school, you've seen many different ways to express the same idea. But do all of those words listed under *see*, for example, really mean the same thing? Or are there shades of difference in meaning between *view*, *behold*, *perceive*, and *observe*? Careful word choice means paying attention to the slight distinctions, which etymologies can help clarify.

If you write poems, stories, plays, speeches, or editorials, these distinctions may exist at the level of sound as well as meaning. Take for example the Anglo-Saxon words *climb*, *kingly*, *sad*, and their Latinate synonyms *ascend*, *sovereign*, and *melancholy*. Similar in meaning, the word pairs have quite different sounds, which a thoughtful writer can use for effect. It might make more sense for a character who speaks in monosyllables to say that he's *sad* instead of *melancholy*; in a line of poetry that needs hard consonant sounds, you'd probably want to use *climb* instead of *ascend*. Carefully choosing words from one source or the other, or intentionally blending them, can have subtle but powerful effects on your audience.

Learning etymologies takes time. Some students make lists or use note cards to help them remember common roots; others learn as they read. No matter what your strategy, by studying etymologies, you'll improve your ability to use and understand the English language. You'll see history at work—even in a single word. And if you're attentive, you'll see the flash of poetry, you'll hear the stories behind the words.

Selected Resources

Dave Wilton's Etymology Page
home.sprynet.com/sprynet/dwilton/etyma1.htm

Focusing on Words
www.wordfocus.com

Fun with Etymology
www.compassnet.com/mrex/etymol.htm

The Logical World of Etymology
www.phoenix.net/~melanie/thelogic.htm

Richard Lederer's Verbivore Page
pw1.netcom.com/~rlederer/index.htm

Where's THAT From? (game)
www.intuitive.com:80/origins/

The Word Detective
www.users.interport.net/~words1/index.html

The Word Wizard
wordwizard.com

Bryson, Bill. *Made in America: An Informal History of English in the United States*. New York: Morrow, 1994.

Carver, Craig M. *A History of English in Its Own Words*. New York: HarperCollins, 1991.

McCrum, Robert, William Cran, and Robert MacNeil. *The Story of English*. New York: Viking Penguin Inc., 1986.

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The Buzz about the Bee:
Winning the 1997 National Spelling Bee

by Rebecca Sealfon

The Scripps Howard National Spelling Bee is a two-day competition held in Washington, D.C. Almost 250 kids from around the country and from U.S. territories, embassies, and military bases are hosted for a week at a fancy hotel, with recreational activities planned daily. To get to Washington, these kids must win at the classroom, school, district, and regional levels. Over nine million kids between grades four and eight begin the process.

I had participated in the 1996 national finals and met so many interesting, diverse, and talented people there that it was one of the best weeks of my life. But I also knew from last year that the competition is serious. To make it back in 1997, my last year of eligibility, I would have to study hard.

Beginning the Monday after I came home, I studied 2–3 hours a day, five days a week. Early in the morning, I would go over the dictionary (which I didn't find very helpful), books of old national and regional word lists, old study booklets that were put out by the bee, vocabulary books, and books about language of origin, roots, prefixes, and suffixes. I also read widely in a variety of fields and made special note of new words. Still, I wasn't sure I'd win. I'd seen a lot of very strong spellers eliminated in early rounds.

A year passed before I knew it, and March 19, the day of the *Daily News* regional spelling bee, arrived. Some spellers study for a whole year and don't make it back. But I made it: as one of two co-champions at the regional bee, I was eligible for the nationals again. I was looking forward to returning, and, I have to admit, I wanted to win!

Before I left for the national finals, I was very nervous. I knew I'd studied hard, but was it enough? I hoped I would be among the top spellers who sit on a dais, apart from all the others, at the awards banquet. These spellers' pictures and bios are included in the next year's study booklet.

The drive from Brooklyn to Washington with my family seemed longer than it should have. But after we finally arrived, time started to pass quickly. Bee Week includes lots of activities where you can meet people with similar interests. The first night, there was a spellers' ice cream party, where I met new friends and was reunited with old ones. The next day there was a barbecue, and a friend, my sister and I went on the second annual homeschoolers' hike. The day after that included a tour of Capitol Hill and an evening event, the Parents' Bee, which my parents were too cowardly to sign up for. The next day the bee would begin!

On the first day of competition, the spellers are divided into two groups based on the first letter of their state. Because I am from New York, I was one of the early spellers in the afternoon group. I correctly spelled my three words: *sesquicentennial, inducement, prejudicial.* I had survived the first day. That night, I tried not to think about what would happen next.

The next morning, I had to be on stage at 7:45. I was so nervous that I couldn't eat. I had trouble walking. Every few steps, I had to take a rest. But the staff was very nice and let me sit offstage. I didn't want to see the bee, but at least I didn't back out.

Finally, it was my turn. I walked to the microphone. *V-a-p-o-r-e-t-t-o.* I sat down, feeling much calmer. Round Five (*bivouac*) passed, followed by a lunch break. Round Six began, and now the spellers were on ESPN. Soon a good friend was out. I had been hoping she would do better. She'd studied really hard. My word was *grosgrain.* Correct.

Last year, I'd survived to Round Seven, and this year I was doing as well. The word was *hippogriff,* which I knew. Now it was Round Eight, which had been the cutoff round for the dais for the previous two years. There were only nine spellers left. Several rounds passed. Now there were seven, now six, now four, now three. I was in! I'd met my goal, surpassed it. Even if I didn't get past this round, I would be sitting next to the champion on the dais!

Now I was sitting onstage. Three more rounds passed and one more person was out, leaving just me and Prem Trivedi.

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Prem and I both got our words right. Several rounds passed before Prem misspelled a word. This was my chance to win the championship! I was given the word *dulcinea*. The bell the judges ring when a contestant misspells a word, the bell I was afraid of, the bell I had studied for a year to try *not* to hear, was rung. According to the rules, we were both back in.

Prem and I bounced back and forth. Correct. Correct. Correct. Correct. Now the bee was 50 minutes overtime on ESPN. After Prem misspelled his word in Round 22, I spelled *coterie*, a word from my vocabulary books. But to win, I had to spell another word: *euonym*, a word I knew from studying Greek roots. "E! U! O! N! Y! M!" I yelled into the microphone. The unbelievable had happened! I had won!

I was immediately interviewed onstage, with about 20 microphones pointed in my direction. After the bee, we made arrangements for other interviews. I was on the *Rosie O'Donnell Show*, the *Geraldo Rivera Show*, CNN, *CBS This Morning*, Brazilian PBS, and countless other programs. I was also interviewed for many articles in various newspapers and magazines and met many politicians. I was asked to be a spokesperson against teen smoking and to work for literacy in Philadelphia. During a radio interview with Mayor Giuliani, I also volunteered to work for literacy in New York City. In addition to being interviewed, I was invited to write several articles. It was one of the best summers of my life.

This year I am attending high school. My school is very competitive, and there is a lot of homework. Since I was homeschooled for five years, it was a big change to go from a school of three to a school of 3,000. But I think studying for and being in the National Spelling Bee was an excellent preparation for these challenges and for my future.

National Language Arts Olympiad
Schools can register multiple teams in October for the April Olympiad. Student participants are tested on spelling, vocabulary, reading comprehension, and grammar. The top ten scores from each team are ranked against those of other schools. Individual and team prizes are given at the national level. *National Language Arts Olympiad, P.O. Box 2196, St. James, NY 11780-0605; (516) 584-2016.*

Scripps Howard National Spelling Bee
Students in grades 7 & 8 enter the competition only through a sponsoring newspaper. Ask your local press if they participate, or find your sponsor on the Spelling Bee's Web site. The winner of the National Spelling Bee wins $6,000 in cash and savings bonds; other finalists receive $50 to $4,000. *Scripps Howard, P.O. Box 5380, Cincinnati, OH 45201; (513) 977-3040, fax (513) 977-3019; bee@scripps.com; www.spellingbee.com*

WordMasters Challenge
Teachers register their 7th and 8th grade classes in mid-October for the National Competition. Classes participate in three "analogies meets," and the top ten scores from each class are ranked on a national level. The highest ranking students in each class receive medals and certificates. *WordMasters, 213 East Allendale Avenue, Allendale, NJ 07401; (201) 327-4201, fax (201) 327-6219.*

National French Contest (Le Grand Concours)
Students of French register individually or through their teacher for the March exam. The top students nationwide and in each chapter receive certificates and medals. *American Association of Teachers of French, Le Grande Concours, P.O. Box 32030, Sarasota, FL 34239; fax (941) 364-9820; www.utsa.edu/aatf/aatf.html*

American Association of Teachers of German Testing and Awards Program
Teachers register students in second-, third-, and fourth-year German for the test by December 1st. Prizes are awarded by each AATG chapter, and range from t-shirts and books to trips to Germany. *American Association of Teachers of German, 112 Haddontowne Court, #104, Cherry Hill, NJ 08034; (609) 795-5553, fax (609) 795-9398; 73740.3231@compuserve.com*

National Greek Exam
Applications for students in grades 9-12 are due in early January and are accepted only from teachers (although home schoolers and others may write to explain special circumstances). High-scorers are eligible to apply for one of two $1,000 scholarships. *National Greek Exam, c/o Department of Classical Studies, University of Michigan, 2016 Angell Hall, Ann Arbor, MI 48109-1003; (313) 747-2300; drdavies@umich.edu; www.umich.edu/~acleague/*

National Italian High School Exam Contest
Students taking Italian I-IV register by the end of February. Prizes for top scorers include trophies and cash prizes up to $200. *American Association of Teachers of Italian, Attn: Bruna Boyle, Narragansett High School, 245 South Pier Road, Narragansett, RI 02882; (401) 738-8457, fax (401) 792-9410.*

National Latin Exam
Teachers register students in Latin I-V by January 10. Contestants are tested on grammar and comprehension, mythology, life, history, and classical literature. Top scorers in the National Competition win certificates and medals. *ACL/NJCL, National Latin Exam, P.O. Box 95, Mount Vernon, VA 22121; (703) 360-4354, fax (703) 455-6779; jhhall@pen.k12.va.us*

Olympiada of Spoken Russian
Each chapter of the ACTR decides whether to hold a local Olympiada—contact your Russian teacher for information. This contest is open to students in Russian I-V. Participants receive medals or honorable mentions; state or regional finalists spend four weeks studying in Russia and living with a Russian family. *American Council of Teachers of Russian, 1776 Massachusetts Avenue, NW, Suite 700, Washington, DC 20036; (201) 816-6618, fax (201) 871-8509.*

National Spanish Examination
Teachers register students for the exam, held between mid-February and mid-March—local coordinators choose the test date. The top three finalists in each level and category are given plaques. Some chapters provide additional awards. *American Association of Teachers of Spanish and Portuguese, 2051 Mt. Zion Drive, Golden, CO 80401; (303) 278-1021, fax (303) 278-6400.*

For more information about student contests, see *The Ultimate Guide to Student Contests: Grades 7–12* by Scott Pendleton (Walker and Company, 1997).

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The Intricacies of Translation and the Creative Role of the Translator

by Lesley Mackay

Translating a text from one language into another involves both mechanics and mystery. Translators must be very knowledgeable about the languages in which they work and about the coincidences between them: for example, *gato* in Spanish has exactly the same meaning as *cat* in English. However, translators must also recognize the unique and even the untranslatable within each language—the elements of vocabulary, syntax, or significance that resist conversion into another idiom.

Reworking Aesthetic Features

A poet, for example, may use aesthetic elements, such as sound, in a way that cannot be transposed into a second language. Consider the following excerpt from a work by Juan Ramon Jiménez and its translation into English by Robert Bly. (Spanish has a strong phonetic basis, so you can read the lines aloud even if you are not familiar with that language):

Una rosa distinta,
de una imprevista majia,
sobre cada hora solitaria de oro o sombra,
hueco propicio a las memorias trágicas.

One particular rose,
that has an unexpected magic,
on top of each lonely hour of gold or shadows,
a place just right to hold painful memories.

Hear the difference? The internal rhymes within Jiménez's description have disappeared: "particular rose" does not provide the resonant echoes of "rosa distinta"; "painful memories" does not deliver the rhythmic effect of "memorias trágicas." It seems that the translator did not aspire to re-create the pleasing sounds of this poem in English.

Reworking Meaning

Perhaps Bly decided to concentrate on approximating Jiménez's ideas as closely as possible. Reproducing ideas in translation is tricky, in part because individual word meanings can be slippery—subtle in their usage and changeable over time. Even cognates, or words in different languages with the same roots, don't always have identical meanings. In Bly's translation of Jiménez, for example, he chose to translate "trágicas" into "painful," not "tragic."

Translators must recognize the unique and even the untranslatable within each language—the elements of vocabulary, syntax, or significance that resist conversion into another idiom.

Bly's decision not to use the English cognate probably relates to the different connotations of *trágicas*/tragic in Spanish-speaking and English-speaking cultures. Any language is profoundly shaped by the special histories and cultures of the people who created it and who continue to develop and use it. Because human societies perceive and describe the world in different ways, language systems can vary enormously. So, keeping a text's meaning intact while moving from one language to another can be very challenging.

Sometimes the word resources of two languages are simply unequal. For example, one of Federico García Lorca's famous poems about New York describes "un huracán de negras palomas." One translator turns this into "a hurricane of black doves" and another into "a hurricane of black pigeons." The reason for the discrepancy? A minute ambiguity in Spanish—one common name for two kinds of birds.

Gaps in a language's word resources can be truly daunting. In *The Poetics of Translation* Willis Barnstone relates that Bronsilaw Zielinski, who translated *Moby Dick* into Polish, had to create a set of words in that language for the elements of the whaling industry. His new words became incorporated into Polish. A translator must feel great satisfaction in permanently adding to a vocabulary.

However, language differences are not limited to the absence of a few specialized words. Variations can be major, extending to tense systems and the most structurally significant parts of speech. For example, the stories that would eventually make up the New Testament were first transcribed in Aramaic, a language that contains no variant of the verb "to be." And so, as Susan Bassnett-McGuire explains in *Translation Studies*, the New Testament, a book that contains many well-known declarations of Christ's identity, was created

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out of a text in which those declarations could not be made.

Because of the array of great and small distinctions among languages, some translators choose to focus on *effect*. For example, a translator may rework an ancient text with the goal of providing contemporary readers with the same reading experience enjoyed by the original audience. This kind of translation relies in part on judgments about the culture in which the text was produced and the culture for which the translation is intended.

Mimesis and Creativity

Translators are faced with difficult choices because they cannot simply clone a text in one language into a text in another. However, the impossibility of simple replication makes translation not just complicated, but also fun and exciting. Some 20th century literary figures such as the Mexican writer Octavio Paz and the French scholar Jacques Derrida have concluded that the business of translation is producing original texts—or texts that are as original as any other. Consider the following basic points in support of their argument:

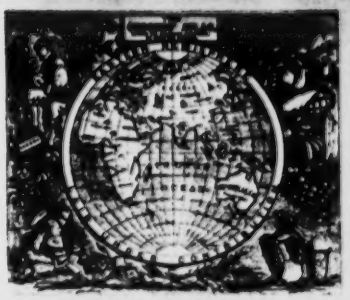
- All *original texts* are, to a degree, borrowed and adapted since they are produced within a tradition in which writers respect and respond to one another.
- All *translations* are, to a degree, original since language systems are incompatible, language elements are slippery in meaning, and since both reading and attempting to re-create a text are interpretive acts.

So, if you love words and languages, if you have the urge to respond to other writers and to create new texts, one of the many paths open to you is that of the translator. *Bonne chance!*

Barnstone, Willis. *The Poetics of Translation*. New Haven: Yale University Press, 1993.

Bassnett-McGuire, Susan. *Translation Studies*. New York: Routledge, 1991.

Interview with a Translator



Interview with Walter Hryshko, graduate [illegible] of Romance languages at Harvard [illegible], teacher of languages, and professional translator. Walter was a high scorer in the Johns Hopkins Talent Search.

How did you get interested in languages?

Members of my family use German, Polish, and Italian, so I grew up in an environment in which it was perfectly natural not to speak English. Also, as a child, I lived in Barcelona while making frequent trips back to the U.S. This probably cemented my multilingual identity.

Please tell us about your undergraduate and graduate work.

As an undergraduate at Harvard, I majored in political science with a minor in Romance languages. I wrote a senior thesis on political corruption in southern Italy. As a graduate student, I teach French, Italian, and Spanish and am currently completing a dissertation on Italian holocaust literature. Few Italian writers were in the camps; my study deals with the effects of racial laws on the literature written in the Jewish quarters of Italian cities.

It sounds as though you have a strong interest in politics and world events.

I'm interested in how political ideas are expressed in literature. For example, I am interested in how Machiavelli's political ideas are advanced by his uncomplicated prose style.

Do you explore cultural issues when you teach languages?

Absolutely. I feel that language students need a great deal of knowledge about a culture's history and everyday conventions. Studying the languages isn't enough. For example, very few people around the world say that they are "doing great" the way that Americans do. So, if I am teaching Americans, say, French, I teach them to moderate their expression of how they are doing, to say that they are "doing okay," for example.

Spanish and French are used by millions in the developing world as well as in Europe. How do you teach cultural information when a language is widely spoken on different continents?

When different cultures share a language, they also share much more, despite obvious differences between them. A certain way of looking at the world is shared. A philosophical perspective or set of interests is shared.

What do you find challenging about professional translation, and what kinds of documents have you translated?

Outside academia, I have translated personal, business, medical, and government documents. There is a tremendous amount of creativity involved in translating seemingly ordinary texts. Cultural differences often emerge, and I couldn't possibly produce a word-for-word translation in most cases. For example, I may be translating a medical document and realize that the two cultures explain illnesses differently. I have to be faithful to the source document, but I am concerned with how the text will be read by individuals in the second culture.

Have you also worked on translations of literary texts and, if so, do you have a particular approach to that task?

I have consulted on poetry translations. I find that I often prefer prose translations of poetry, especially of long poems such as those of Dante. I find verse translations to be a bit too contrived. The effort to fit in a rhyme scheme or meter to achieve a poetic flow can leave the poem forced and over-thought.

What is your professional goal?

To teach—to become a tenure-track professor of languages at an American university. I like teaching college students and adults. They tend to know the grammar of their own language and to have a strong native vocabulary, so I can teach at a level that's more advanced.

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The Importance of Being Grammatical

by Eileen Ptak

Have you ever wondered—perhaps while you were struggling to remember what a pluperfect tense is—why you had to learn grammar at all? Is there a reason, other than to pass seventh-grade English, to study grammatical cases, rules, and exceptions to the rules?

Clarity! The obvious aim of writing and speaking is to communicate well. If your papers are riddled with grammar mistakes, your reader may be unsure of your point—and your writing ability.

Say What You Mean

Grammar is simply the underlying structure of language. Familiarity with the rules of grammar helps you organize and clarify your ideas. If you're careless with the basic rules, you might not say what you intend.

For example, *modifiers*, words that describe (or modify) other words in the sentence, should be as close as possible to the words they modify. When they are too far away, the result can be confusing or ridiculous. In the book *More Anguished English*, Richard Lederer recalls a sign posted at a gas station in Santa Fe, New Mexico: "We refuse to sell gas to anyone in a glass container." On the sign, the phrase *in a glass container* modifies *anyone* instead of *gas*.

In another case of a dangling modifier, an advertisement claims that an electronic pest repeller emits vibration and sound that are "intensely annoying to underground rodents up to 100 feet in diameter." Because the phrase *up to 100 feet in diameter* dangles at the end of the sentence, it modifies *rodents*. In this ad, the company is unintentionally making a claim it cannot prove—unless it has discovered some gigantic groundhogs.

Comma Placement, Blue Suede Shoes, and Shakespeare

The rules of punctuation were designed to ensure that your written sentences will be properly understood. Commas are perhaps the most misused element of punctuation, but when used correctly, they can measurably improve the intelligibility of your writing.

Commas can be used to set off nonessential elements—phrases and clauses that aren't critical to the sentence. These nonessential elements are sometimes called *nonrestrictive* or *nondefining* elements because they don't define anything in the sentence—they simply give more information.

In the sentence "My shoes, which are made of blue suede, match my hat perfectly," the phrase *which are made of blue suede* is not essential; it does not *define* the shoes, it gives you more information about them. The nondefining element is therefore set off by commas. However, in the sentence "When it started raining, I regretted wearing shoes that were made of blue suede," the phrase *that were made of blue suede* is defining and essential. When it started raining, the speaker didn't regret wearing shoes; she regretted wearing blue suede shoes. This defining element should not be set off by commas.

Grammar is simply the underlying structure of language. Familiarity with the rules of grammar helps you organize and clarify your ideas. If you're careless with the basic rules, you might not say what you intend.

Be careful not to surround essential phrases with commas. It is incorrect to write, "Shakespeare's play, *Romeo and Juliet*, is about star-crossed lovers." Since Shakespeare wrote many plays, the phrase *Shakespeare's play* does not provide enough information. We need to know which play is "about star-crossed lovers." This essential phrase should not be set off by commas.

Writing the Rules

Surprisingly, English grammar wasn't codified until the middle of the 18th century. For hundreds of years, people dangled modifiers and threw commas anywhere they wanted. So why did people start to care about sentence structure in the mid-1700s?

It was the Age of Reason, which was characterized by the desire to bring order to the world. In physics, scientists studied the rules that governed the universe; in biology, they classified all living things into logical categories. Amid this drive to organize, people realized that the English language needed solid structural standards. A few attempts had been made to establish standards, but their effects were minimal. In fact, Jonathan Swift wrote a letter to a government official calling for the formation of an academy of scholars who would correct and stabilize English, arguing that "our Language is extremely imperfect, that its daily Improvements are by no means in proportion to its daily Corruptions."

In 1755 Samuel Johnson published the comprehensive *Dictionary of the English Language*, one of the first attempts to codify the spelling and definition of words. Johnson's intention was to "refine our language to grammatical purity, and to clear it from colloquial barbarisms, licentious idioms, and irregular combinations." Grammarians followed Johnson's lead with a number of grammar guides. One of the most famous was Robert Lowth's *A Short Introduction to English Grammar*, published in 1762. In it, Lowth made distinctions between proper and improper grammar. He denounced the phrase "I had rather"—a corruption of "I would rather"—which he claimed "is by no means reducible to any grammatical construction." Also, the expression "you was" had been acceptable phrasing until Lowth and Joseph Priestly, another famous grammarian, decided that "you were" was more appropriate.

Lightening Up

In contrast to the 18th century's desire for a fixed structure and strict adherence to the rules, today's grammatical climate is much more relaxed. Some phrases that

continued on page 2

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GRAMMARRRRGGHH!!!

Jonathan Freeman's Book Makes Grammar Fun

Shortly after receiving his bachelor's degree from Yale University, Jonathan Freeman began teaching English at the Bryn Mawr School in Baltimore, Maryland. To help make learning grammar more enjoyable for his junior high school students, he wrote GRAMMARRRRGGHH!!!, ***a book that uses funny explanations and examples about teenage life. The book has become so popular that he is now creating customized editions for other schools.***

Why is grammar important?

Because it makes a difference. Proper grammar can improve your writing. Knowing the confines of the language can turn merely adequate writing into outstanding writing. The way you speak and write influences the way others perceive you. Sometimes, the correct use of language can be the difference between the candidate who gets the job and the candidate who doesn't.

What are the most common grammar mistakes made by students?

A lot of students tend to mistake *it's* and *its*, and I can tell you why they do that: it makes common sense. You use an *'s* to indicate a possessive, but *it's* means *it is*, while *its* is the possessive form. English is a weird language—weirder than a lot of other ones out there. Some of the mistakes are logically flawless, but that doesn't matter when they're dealing with a language that is, by nature, illogical.

What was the impetus to write your own grammar book?

The sheer necessity for something that combated the drudgery and boredom of most of the other grammar books until this time. I got tired of giving students readings that dealt with the material adequately and correctly, but whose texts were extremely dry and boring. The material in my book is no different, but the way it's presented makes all the difference in the world.

What did you hope to achieve with this book?

I wanted to demystify a lot of the high holy laws of grammar as they were presented by dictatorial teachers, who tend to be insistent about absolute adherence to the rules. I would hope to impart to my readers that we're all human, we all make mistakes, but you need to learn the rules and learn how to catch yourself committing mistakes—not in the first draft (that's what drafts are for), but maybe the second or third time around.

I wanted to give my readers a more liberal interpretation of the rules of English. There's nothing in my book that says you may never split an infinitive. The general rule, as I interpret it, is that you should not split an infinitive unless the alternatives are markedly inferior. The Star Trek motto does not work as well as "To go boldly...." And I don't think anyone would ever say, "Your behavior is something up with which I will not put." Yet, the more concise version requires that you end the sentence with a preposition. I'm striving for overall vigilance, but with the occasional permission to break those rules in the pursuit of larger goals, like clarity and concision.

How have your students reacted to your book?

They like it. The thing that shocked me the most was when students told me early in the school year that they had gone home and read the whole book. I was flattered; I hadn't expected that degree of enthusiasm.

Have other schools purchased it?

Yes, 20 schools so far have purchased the book. I'm incredibly flattered whenever a teacher tells me, "This is exactly what I've been looking for." Every once in a while I step back and think, wow, several hundred students are reading my words and, I hope, laughing.

I make a different edition for each school because it works best for the students if it is relevant to their lives—not only in the general sense of talking about teenage life and middle school experiences, but also in the very specific sense of mentioning their friends, their teachers, their school's traditions and idiosyncracies. When other schools started expressing interest, I quickly realized that references to Mr. Freeman and his colleagues were going to fall flat because they were not relevant. So I made a database on the computer, and now I can make customized editions.

For information about ordering GRAMMARRRRGGHH!!!, contact the Bryn Mawr School bookstore at (410) 323-8800.

Excerpts from *GRAMMARRRRGGHH!!!*

- **Noun Clauses:** Sometimes—and this is where we begin to despise whoever invented English—a whole bunch of words get together and form a gigantic, scary, fire-breathing noun when one word just won't do the job.

Whoever ate the last Ring Ding is in big trouble. (That bunch of words still indicates a person.)

- **Commands** (or imperatives) only look like they have no subject.

Stop *feeding dirt to your little brother!*

Actually the subject of the command is "you."

- **Subject-Verb Agreement:** **Collective nouns** refer to groups of objects, but are themselves singular.

My ***collection*** *of Englebert Humperdink* ***records is*** *quite valuable.*

- ***Beware*** **the Passive Voice:** Avoid the passive voice whenever possible. It's weak and ugly, it has bad manners, and it breaks another of the cardinal rules of English: Without sacrificing detail or feeling, be as concise as possible. (Translation: Say what you're going to say in the fewest number of words.)

The passive voice ***is hated by*** *just about every English teacher. Poor grades* ***are received by*** *students who insist on using it.*

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From the Inside Out: How to Read a Poem

by Melissa Hartman

[illegible] in the middle of the page, surrounded by white space. Its jagged lines alert you before you even start reading: you've encountered a poem.

Because they don't look like the writing we encounter most often, poems can be intimidating even in appearance. However, a poem's shape is really the first indication that we need to read it differently than we would read a newspaper article or a chapter in a textbook. To understand, appreciate, and enjoy a poem, we have to use a unique approach.

Getting Inside the Poem

First, give yourself plenty of time to read a poem. If you're reading poems as part of a homework assignment, don't wait until the last minute. Although a page of poetry typically has fewer words than a page of prose, you will have to read those words many times.

In your first reading, don't try to understand everything at once. Read through the whole poem without stopping; even if you come across unfamiliar words or difficult passages, keep reading. After you've finished, look up unfamiliar words as well as familiar words used in unusual ways. Whatever larger meanings you draw from the poem will have roots in the individual words the poet has chosen, so pay careful attention to them in your early readings.

Once you have a sense of the meanings of all the words, try to write a paraphrase of the poem. This will require you to work through the poem line by line, untangling complex sentences, translating elevated, metaphorical, or archaic expressions into more common language, and articulating the poem's messages in relatively literal terms. Paraphrasing will clarify your understanding of the poem's central ideas, and you'll be prepared to focus on the poetry—the artistic use and arrangement of the words themselves—in successive readings.

Use Your Senses

Even in your first reading, you might notice a striking description that invites you to experience the poem with your senses. In "At the Fishhouses," for example, instead of simply telling us that fish scales cover everything, Elizabeth Bishop paints a word picture that allows us to see the place for ourselves:

> *The big fish tubs are completely lined*
> *with layers of beautiful herring scales*
> *and the wheelbarrows are similarly plastered*
> *with creamy iridescent coats of mail*
> *with small iridescent flies crawling on them.*

By noticing the use of imagery throughout the poem, you might begin to sense its tone. What is the overall impression the imagery creates? In Bishop's poem, the "beautiful" and "iridescent" scales are later described as "sequins" and "the principal beauty" of the fish, all of which have positive associations. Noticing not only *what* you see (or hear, smell, feel, or taste) but also *how* you see it, you'll begin to make fuller readings of the poem.

Put Your Ear to the Line

Margaret Atwood wrote in "Reading Blind" that written words are "a score for voice," that "those little black marks on the page mean nothing without their retranslation into sound." This is especially true of poems, which often use sound for effect. You'll notice these effects best if you read the poem out loud.

Repeating sounds creates emphasis—when we hear something more than once, we're likely to pay more attention to it. In addition, when words are linked in sound, we're more likely to link them in meaning. When a poem rhymes, for example, our ears make connections between words. In Robert Frost's "Nothing Gold Can Stay," the lines are short (only four to six words each), so the rhymes are very noticeable:

> *Nature's first green is gold*
> *Her hardest hue to hold.*

The poem's paired end words—*gold, hold; flower, hour; leaf, grief;* and *day, stay*—emphasize the passage of time and the poet's attitude about it (*hold, hour, grief,* and *stay*) as well as what is lost as time passes (*gold, flower, leaf,* and *day*). The rhymes emphasize the connections among these words, which underscores the poem's principal message.

Don't stop with end rhymes, however; look inside the lines for sound repetition. In "Nothing Gold Can Stay," you'll find consonance, which occurs when two words share all the same consonant sounds but different vowel sounds: "So ***dawn*** goes ***down*** to day." Consonance is a

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kind of slant rhyme; by not giving us an exact match, slant rhyme can convey opposition, negation, denial, or, as it does in this line, a let-down. Frost's poem also relies heavily on alliteration, the repetition of individual consonant sounds. In the first line, *green* and *gold* are alliterative, as are *Her, hardest, hue,* and *hold* in the second line. You'll also hear assonance, the repetition of vowel sounds: the long "e" sound is repeated in *green, leaf* (which appears three times), *Eden,* and *grief.* We can see a progression even in these four sound-related words: as the first three are lost with the passage of time, we're left with *grief,* which again reinforces the poem's meaning.

Examine the Structure

As you read more and more poems, train your ear to notice stresses and pauses. By controlling the placement of stressed syllables in combinations of words, poets can create a rhythm, as in these lines by Tennyson:

Break, break, break,
On thy cold gray stones, O Sea!

Read the lines aloud. Which words receive stresses? The stresses, which result from both the long vowel sounds and the punctuation, create a rhythm that helps to convey the sound of waves breaking on the rocks. The rhythm is forceful, unrelenting.

As you read a poem out loud, mark the stressed (ˊ) and unstressed syllables (˘). If stresses and pauses occur in a regular pattern, you've probably encountered a poem in accentual-syllabic meter, in which line length is determined by the number of both stresses and syllables. If you don't notice a pattern emerging, see if line length is determined in another way. Perhaps the poet has counted only stresses (accentual meter) or only syllables (syllabic verse).

If the poem is broken into stanzas, groups of lines separated by white space, look for patterns such as stanza length and rhyme scheme. In "I Wandered Lonely as a Cloud," for example, the stanzas are sestets, rhymed stanzas of six lines each. These sestets follow a rhyme scheme of ABABCC, DEDEFF, GHGHII, JKJKLL. Just at the level of form, then, we know a lot about the poem: the lines are iambic tetrameter, the stanzas are sestets, and it has an identifiable rhyme scheme. The poem is written in a closed form.

Many closed forms, such as the sonnet, sestina, and villanelle, have long histories as well as strict rules. Much like a word's origin and history can give you greater insight into its meaning, knowing the history behind a form can provide additional insight into the meaning of a poem. On the other hand, a poet may create a form to fit the content of the poem. For instance, Sylvia Plath's poem "Metaphors" is nine lines long and each line has nine syllables. The poem is written in the voice of a pregnant woman; the form of the poem corresponds to the nine months of pregnancy.

Scanning a Poem

Scanning a poem means marking its stressed (ˊ) and unstressed (˘) syllables. When you scan William Wordsworth's "I Wandered Lonely as a Cloud," you'll begin to notice a regular pattern:

Ĭ wándĕred lónĕly ás ă cloúd
That flóats ŏn hígh ó'er vále ănd hílls,
When ál ăt ónce Ĭ sáw ă crówd,
A hóst ŏf góldĕn dáffŏdíls,
Bĕsíde thĕ láke, bĕnéath thĕ trées,
Fluttĕríng ănd dancĭng ín thĕ bréeze.

The meter is disrupted only in the last line, where the departure from the regular pattern helps convey the motion of the daffodils.

The pattern of stresses and pauses in this poem is predominantly iambic (˘ˊ). Since there are four iambs in each line, the meter is iambic tetrameter.

Metrical Foot	*Mark*	*Example*
iamb	˘ˊ	niCOLE
trochee	ˊ˘	DENnis
anapest	˘˘ˊ	saraJANE
dactyl	ˊ˘˘	ANdrea
spondee	ˊˊ	JOHN DOE

Number of Feet	*Metrical Term*
one	monometer
two	dimeter
three	trimeter
four	tetrameter
five	pentameter
six	hexameter

47 BEST COPY AVAILABLE

A Notebook of Questions:

A Summer Inquiry into Literature and Language

by Katy Wischow

That first night, after arrivals and non-arrivals, introductions and pizza, a brave soul said, "Let's talk about religion." So we did. Eighteen of us, participants in the 1997 Telluride Association Summer Program (TASP), trooped upstairs to a dorm room, squeezed onto beds, chairs, and the floor, and talked. I didn't know everyone's name, but I learned what they thought about God and prayer. Sometime after midnight, I went to bed, grinning all the way up the stairs at the promising start to the program.

The Telluride Association fosters intellectual communities in part by sponsoring free summer programs for rising high school seniors. Every summer, 15–20 students participate in each of four six-week programs held on college or university campuses. The competition for these programs is intense. Along with the usual transcript and recommendation, the application requires a list of books recently read, a short essay ranking seminar choices, and four long essays on topics such as future goals, a challenge faced, and a significant aspect of a book. The Association interviewed 150 finalists in March before making their selections.

I chose "Language and Literature," held at St. John's College in Annapolis, Maryland. I left for Annapolis a week after school let out, a bit nervous. I knew the program would center on language—how it relates to society, how accurate it is, how names gain meaning. One particular sentence in the program brochure attracted me the most: "Given that language is unavoidably the means by which we study language, how can the study of language be undertaken at all?" The course sounded intriguing and intensely intellectual. I wasn't sure I could read and write up to the expectations of the program, or up to the quality of my fellow TASPers. The formidable reading list I received when I arrived in Annapolis only added to my anxiety.

However, ready or not, I quickly fell into the program routine. On Mondays, Wednesdays, and Fridays, we discussed linguistic philosophy through texts by Plato, Aristotle, and Augustine up through modern writers such as Katz, Heidegger, and Foucault. Some, like Aristotle, were dense and difficult to navigate. Others, like John Austin and Ludwig Wittgenstein, met with great acclaim among the students. We devoted Tuesdays and Thursdays to in-depth readings of literary works; favorites included *Hamlet*, plays by Ionesco, stories by Borges, and a variety of poems.

I grew more confident in my abilities, not only those I had developed at home, but also others nurtured by TASP such as the ability to participate in a good discussion, synthesize ideas, read a lot of material closely, make connections, and speak assertively about my own thoughts.

After a week of classes, my anxiety subsided. I grew more confident in my abilities, not only those I had developed at home, but also others nurtured by TASP such as the ability to participate in a good discussion, synthesize ideas, read a lot of material closely, make connections, and speak assertively about my own thoughts. These qualities were strengthened in the seminar we attended for two hours each weekday morning.

Developed and led by two St. John's tutors, our program was heavily influenced by the St. John's College philosophy, which embraces the Great Books program; students at the college read primary sources in philosophy, science, language, and other subjects. My fellow TASPers and I were exposed to several of these texts as well as to other books. Our classes were run as open discussions with the tutors participating as fellow learners. In the St. John's tradition, we maintained a formal atmosphere by referring to each other as Mr. and Ms.

During the six weeks, we wrote two papers about topics inspired by any of the readings. My first paper attempted to answer the question Yeats posed in "Among School Children": "O body swayed to music, O brightening glance/How can we know the dancer from the dance?" by exploring it in light of some of the philosophers we read, particularly John Locke. I spent an entire weekend in a daze, obsessed with exploring the subtleties of this question. My second paper addressed the thorny problem of "ideal language." I came to a tentative conclusion that embraced precision in language, rather than perfection, looking at how works of literature would be affected by more or less precision. My tutor gave me detailed written comments as well as a half-hour conference on each essay. During the conferences, rather than pointing out the papers' flaws, the tutors addressed something they disagreed with or liked, and we had a discussion about the topic.

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The best emblem of my experience at the St. John's TASP is a question mark. I asked more questions than I answered about philosophy and literature, language and life. When my essays ended with more questions than they had originally posed, my tutors just nodded and smiled. Now that the program is over, I have a notebook filled with scribbled queries, none of which has a tidy answer. How do you read literature? In interpreting a text, should you consider an author's life or the work only? How does a society use language? What does a society's use of language say about the society? What in life and in literature is truly amazing?

An endless series of question marks may not yield a neat term paper. But daring to ask questions that don't have answers provides an opportunity for intellectual stimulation that I feel incredibly lucky to have experienced. ■

Katy Wischow is a senior at the Governor's School for Government and International Studies in Richmond, VA. She is active in Odyssey of the Mind and drama, and is fascinated by language. You may email her at lndirabbit@aol.com if you have questions about TASP.

TASP course offerings have varied every year since the program began in 1954. Past courses have focused on such diverse topics as Politics of Culture; Science as Literature, Literature as Science; Cinema and Modernity; and The Experience of the Writer. The seminars, similar to upper-level college classes, are led by experienced college and university faculty.

Telluride Association selects high school juniors who may apply to the summer programs on the basis of PSAT scores or nominations by teachers or counselors. Applicants who are accepted to the program receive a full scholarship that covers tuition, housing, dining, and books. For more information, see the Telluride Association Web site at www.telluride.cornell.edu

Teachers and counselors interested in nominating students for TASP should contact Telluride Association, 217 West Avenue, Ithaca, NY 14850; (607) 273-5011.

***How to Read a Poem** (continued from page 13)*

Again, don't give up if no patterns emerge. Many excellent poems aren't broken into stanzas, written in lines of set length, or arranged according to a rhyme scheme. Called free verse or open forms, these poems present unique pleasures and challenges to the reader, most notably at the level of line. If the lines aren't of set length, consider why the lines are broken the way they are. Perhaps the poet has broken lines at syntactical or grammatical pauses, to create rhythm, or even for visual effect. In any case, try to determine the relationship between form and content.

Seeing it Whole

While it's important to analyze the elements of the poem individually, you'll also need to consider the parts of the poem together, to notice how they work together to create the overall meaning of the poem. After you've read the poem several times, try to state the poem's theme—what the poem as a whole seems to say about its subject. How do form, sound, and imagery combine to support this theme?

In answering this question, keep in mind that a poem is more than the sum of its parts. Even after you've analyzed the elements, you might find that parts of the poem still defy explanation. Part of the allure of a good poem is its power to show us something new each time we read it.

And so, allow yourself some flexibility in your readings. There is no "right" interpretation of a poem. Because we all bring different experiences and perspectives to a poem, we'll interpret it in unique ways. So open a volume of poems and hear what they say to you. All you need is an open mind and a willingness to discover. ■

Figurative Language

While imagery can be created through literal description, poets often use figurative language to help create powerful images. Some commonly used figures of speech include similes, metaphors, and personification.

In a simile, the poet compares two unlike things using "like" or "as":

The dismantled, oily parts
of a machine laid out on rags
like a metal picnic

—Chase Twichell, "19 Lake Street"

A metaphor sets up an equation between two unlike things—it says that one thing is another:

As I walked out one evening,
Walking down Bristol Street,
The crowds upon the pavement
Were fields of harvest wheat.

—W.H. Auden, "As I Walked Out One Evening"

Metaphors may be implicit, not connecting the two objects with "is":

The yellow fog that rubs its back upon the window-panes
The yellow smoke that rubs its muzzle on the window-panes
Licked its tongue into the corners of evening

—T.S. Eliot, "The Love Song of J. Alfred Prufrock"

Personification is a type of metaphor in which human qualities are attributed to non-human things:

Peddling
From door to door
Night sells
Black bags of peppermint stars

—Frank Marshall Davis, "Four Glimpses of Night"

49 BEST COPY AVAILABLE

A Union of

Inspired by the contemplative wisdom of Indian and Tibetan monks and the fierce intensity of ancient Chinese warriors, the martial arts are a set of challenging practices through which you can develop your body, your mind, and the evolving union between them. We hope that this overview of these intriguing disciplines will encourage you to investigate one of them for yourself.

Karate, ***kung fu,*** and ***tae kwon do*** are combative disciplines in which opponents deliver powerful hand and foot blows to defeat one another. *Karate*, the Japanese version of this art, is the most widely known and practiced; *kung fu* is a Chinese antecedent; *tae kwon do* is a Korean variation with a slightly greater emphasis on kicking. These disciplines incorporate numerous styles and sub-styles that feature different hitting and kicking strategies and distinctive approaches to technique, formality, ritual, strength, speed, and precision.

Aikido is a Japanese art that features sophisticated strategies for combating physical aggression. This practice exemplifies the martial arts' traditional focus on self-protection against an unprovoked attack. Opponents attempt to neutralize one another by moving their limbs in circles and then locking one another's joints by twisting wrists, elbows, and shoulders. *Aikido* incapacitates, but does not harm, an opponent.

Most of the martial arts have ancient historical origins. However, ***judo*** was developed by a Japanese teacher in the 19th century as a self-defense practice that would enhance physical conditioning. *Judo* embodies one of the key tenets of the martial arts: in physical combat, a relatively weak or small person can topple a more formidable opponent by using that opponent's weight and strength against him. Combatants grapple and make full-body throws to subvert kicks and hand-blows leveled against each other's weak spots. Learning to fall hard and fast is essential to the practice of *judo*, which today is practiced mostly as a sport on mats in special halls called *dojos*.

All of the martial arts are stylized, but perhaps the most ritualistic is ***kendo***, a variation on ancient Japanese swordsmanship in which opponents strike one another with long bamboo weapons wrapped in leather, or, while in training, with short wooden swords. Rivals in *kendo* formally call out and then hit target areas on their opponent's head, side, throat, or wrists. As you might imagine, protective clothing and equipment must be layered underneath and on top of the traditional flowing *kendo* costume.

Anisha stands in a guard with her [illegible]

The martial arts were conceived as war-like practices, but not all disciplines are combative. Students of ***tai chi chuan***, or ***tai chi,*** perform beautiful sequences of slow-motion gestures. The sustained, full-bodied moves of *tai chi* are practiced not for self-defense, but for the development of flexibility, balance, coordination, and serenity. If you get up at sunrise and head out to a park or river's edge, you may see dedicated *tai chi* artists moving in silent unison, aligning their bodies and composing their minds in preparation for the coming day. You may even decide to join them. ■

Slow-motion kicks, part of Anisha's intense physical workout

Karate: Developing Focus, Force, and Fitness

by Anisha Patel

From second through seventh grade, I watched my brother take karate classes while I waited for my gymnastics lessons to begin. I secretly harbored an interest in pursuing martial arts, and my brother taught me little bits and pieces of karate, using the living room as a makeshift *dojo*. When I entered seventh grade, my parents enrolled me in karate classes. At last, I was able to pursue karate seriously.

Years of gymnastics training had prepared me for the vigorous workouts of sit-ups, push-ups, and squats followed by practice sessions. But I was not expecting the level of intensity and the amount of mental focus karate training required. Because most techniques are never practiced against a person or pad, I had to envision my opponent and perform with the force I would use if my life were threatened. I had to focus all my energy on my target. Everything I did, from the fast-paced workouts to the traditional punches and kicks, required everything I had.

I have now been studying karate for five years. To advance in rank, I have had to learn both martial art and karate history. In addition, I must know the purpose of each movement I execute; simply to perform the moves without knowing their purpose is meaningless. When performing a block, I need to know if

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BODY AND M

I'm blocking a punch or a kick and whether it is coming to my head or to my body. I need to know if my attacker is stepping straight at me or to the side. I need to understand why I am blocking with an open hand instead of a closed hand, or the side of the hand instead of the palm. All of these considerations allow me to perform the moves correctly and effectively.

The suansu, the most difficult move of kata

I am studying *Isshinryu* karate, which focuses on forceful straight kicks, blocks, and punches while protecting the body. There are no twist punches or high kicks because everything is done with the specific intent to hurt the opponent. A kick to the head is useless compared to a strong kick to the pelvis or to the knee. Depending on what kind of kick I am doing, I can kick through two or three wooden boards because I am able to put my body behind it. Similarly, the use of weapons is limited to forceful, purposeful movements; the types of weapons themselves allow no embellishment. The two main weapons are the *bo* (a long, straight stick about six feet tall) and *sai* (two matching metal swords with pointed tips). The *sai* are heavy and difficult to maneuver; I have dropped them many times—each time I was lucky they did not fall on my feet.

The kata chinto

As I've progressed through the different levels of karate, I've noticed the importance of mental acuity. For example, *kata* are series of moves that use a variety of blocks, punches, and kicks to defeat multiple imaginary opponents. These movements require incredible focus and intensity: I have to be able to put the movements together as if I were really fighting someone, as if my life depended on each kick, punch, or block. I imagine myself in the situation until I can almost see my opponents coming after me, kicking me, blocking my technique, and counterattacking. When watching people perform *kata*, it is easy to tell who is systematically defeating opponents and who is merely completing the motions. Look at their faces; look into their eyes: the concentration and fierceness are written boldly, as if carved in stone.

The ranking system for *Isshinryu* karate begins with tenth *kyu*. As the number of the *kyu* decreases, the rank increases. You start as a white belt and work your way up to a brown belt with two black stripes, or a first *kyu*. The next rank is the first degree black belt, which is my current level. A first degree black belt, or *shodan*, can work his or her way up to ninth degree, or *kudan*.

With each advance in rank, more benefits are derived from the martial arts. I have gained much from karate both physically and mentally. It provides a focus for my energy and an outlet for my frustration. There is no better way to relieve stress than kicking or punching a pad as hard as I can. It is also an excellent form of exercise because it requires both physical participation and mental concentration. I go into each class knowing that if I put everything into that class, I will walk out a stronger person.

The cat stance, using the bo as a guard

Getting my black belt was one of the greatest achievements of my life. After a full day of testing, which included running three miles, sparring five black belts in a row, breaking boards, performing all my *kata*, and using my weapons, I was able to see years of work come together. But my black belt was not the conclusion of my journey—it was only the beginning. ■

Anisha Patel is a senior at high school and plans to study chemical engineering in college. An avid tennis player, Anisha also spends much of her free time performing community service.

Anisha wishes to thank her senseis, John and Cindy Ingram.

51 BEST COPY AVAILABLE

On Linguistics, Patterns, and Passing French

by Brian Michalowski

Few of you have ever read this sentence before.

This may seem like a singularly uninteresting observation. However, what you did with that sentence is quite remarkable. By looking at a pattern of ink you'd never seen before, you let an idea that was in my head suddenly enter yours. What's more, you did it so quickly that you didn't even notice most of what happened.

Learning More Than You Were Taught

There are many things that native speakers of a language do without realizing—things they know that no one ever taught them. Go back and reread the first sentence of this article out loud. Go on, do it. If you're like me, you didn't pronounce the [t] in "sentence"; what you said sounded more like "sen-ns" than "sentens." In most dialects of English, the sound [t] turns into what is known as a glottal stop immediately before an [n]. (Glottal stops are commonly described as the consonant sound between the vowels in the word "uh-oh.") Similarly, you pronounce "kitten" as "kih-n" and "Clinton" as "clin-n."

The opening sentence of this article also provides an example of a rule of syntax you've never been taught: You know that you can use the word "ever" in the sentence "Few of you have ever read this sentence before" but not in "Many of you have ever read this sentence before." No one ever told you this, and if you asked your English teacher why you can use "ever" in the first sentence but not in the second, he or she probably won't be able to tell you.

The Search for Patterns

You may ask, "So how do I know this stuff?" This is one of the basic questions that linguistics, the study of language, tries to answer. Linguistics tries to discover how languages work, how people use language, and what the structure of language can tell us about the human brain.

By many accounts, there have been at least 8,000 different languages over the course of human history. They incorporate hundreds of different sounds (and movements, in the case of sign languages,) have wildly different word orders and grammatical constructs, and teem with idiosyncrasies. One of linguists' daunting tasks is to figure out what these languages have in common.

They have found a lot of similarities so far. Phonologists, who study the sounds used in language, have noticed that when two sounds need to be produced consecutively in the same area of the mouth (say, for example, [t] and [n]), people will often change one of them to make the word easier to pronounce. Although languages differ in what sounds cannot appear consecutively, speakers of different languages change sounds in similar ways to avoid forbidden combinations. Syntacticians, who study sentence structure, have noticed similarities in the way sentences are created in different languages. In all languages, words are built into phrases that are then built into larger phrases until a sentence is formed. Words may be positioned differently, but the way the phrases are combined is similar.

Some of the most interesting similarities occur in psycholinguistics, which examines how people acquire language and how the human brain processes language. People who study language acquisition have noticed that all babies babble when they're first learning language, even babies learning a sign language. Babies learning sign make random gestures resembling sign language just like babies learning speech make random sounds resembling spoken language. In fact, people learning any language go through similar stages. Linguistics provides constant reminders that the differences among people aren't as vast as they seem, which is one of the reasons I like studying it.

Psycholinguists also search for patterns in the way we process language. For example, most people can understand "After running a mile John was tired," but they will have difficulty with "After running a mile seemed like a long distance." It takes us a few rereadings to figure out that there's a pause between "running" and "a mile." (Note that this is not a punctuation error. This sentence does not need a comma any more than the sentence "After dinner John went dancing" needs one.) To learn more about language processing, psycholinguists equip test subjects with eye trackers and give them sentences such as these to pinpoint exactly where they get confused and start rereading the sentence.

Linguistics and Natural Language Processing

I first became interested in linguistics while taking a class in natural language processing during my junior year at the University of Maryland. Natural language processing (NLP) is a subfield of artificial intelligence that attempts to get computers to understand human languages. (It's called "natural language processing" to show that it isn't concerned with man-made programming languages such as C and Java.) NLP draws heavily on both computer science and linguistics; my class, which turned out to be one of my favorite classes at Maryland, focused on linguistics.

Natural language processing does have a lot in common with linguistics, but while linguistics focuses on how speakers create an utterance, NLP focuses on how to interpret the utterance that the speaker created. NLP is commonly used in natural-language interfaces, which allow people to interact with computers using their native language. Another application of NLP that I find interesting is machine translation, the subfield of NLP that explores how to automatically translate documents from one

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language to another. Machine translation has received much more attention now that the World Wide Web has made information in many languages widely accessible.

Both linguistics and natural language processing have an ambitious goal—to analyze human language in all of its complexity. The variety in human language can seem bewildering, as any of you studying a second language have probably noticed. Linguists are doing their best to find the universal patterns, and while it won't necessarily help you do better on your French exam, it's nice knowing there's at least some order in the chaos.

If you're interested in the science of language, I strongly recommend the book* The Language Instinct *by Steven Pinker. Pinker does a wonderful job of showing that linguistics is more than syntax trees and vowel charts. He spends a chapter covering each of the major subfields of linguistics, such as phonology, syntax, and psycholinguistics. He then uses the information presented in these chapters to argue that language is as much an instinct in humans as web building is in spiders. The book is a comprehensive and amazing work. The fact that it is sprinkled with quotes from such renowned experts as Woody Allen and Dave Barry helps. After all, linguists aren't the only ones who have discovered that language is fun to play with.

Brian Michalowski

Intelligent Computers, Propp-osed

by Joseph Turian

Theoretically, if computer hardware were powerful enough, a computer could mimic human intelligence. From a purely biological standpoint, the human brain is just a massively parallel computer, the neural equivalent of a gargantuan super-computer with 100 billion Pentium processors. A human is roughly one million times smarter than the smartest computer. Makes you feel pretty good, huh?

Wait a second, you ask, if I am one million times smarter than a computer, then why can a computer beat me at chess and gnash numbers I can't conceive of for breakfast? Computer intelligence lies in precision. As long as a computer has exact instructions for performing a specific task, it can do that task pretty darn well. Perhaps human intelligence is an evolutionary compromise between ability and range.

In the long run, our inability to remember things perfectly and multiply with amazing grace may actually be a stronger form of intelligence than computerized perfection.

In the long run, our inability to remember things perfectly and multiply with amazing grace may actually be a stronger form of intelligence than computerized perfection. The human mind is rapidly able to assimilate and analyze novel situations by reasoning inductively from previous experience and knowledge. To create a sentence, we construct new ideas and new sentences from previous experience using memorized syntax, grammar, and vocabulary. So, using relatively few general rules, we are able to respond to specific circumstances with which we are unfamiliar.

It would be impossible for a human, let alone a computer, to memorize every possible circumstance in real life. Computers, like humans, need to sacrifice range in order to accomplish such real world tasks as understanding and creating speech.

The Syntax of Fairy Tales

For example, a computer program that creates traditional fairy tales could use a few general rules to generate a plot skeleton. Ideally, we would want the program to devise the general rules by itself through examining classic fairy tales. But we can also do this ourselves: by analyzing the structure of the tales, we can arrive at the general rules—a syntax for fairy tales. In fact, in *The Morphology of the Folktale*, Vladimir Propp constructed a sweeping syntax that characterizes the narrative structure of most fairy tales.

Intuitively we know that the hero does not first kill the dragon with the magical sword, then get the magical sword from the fairies in return for magic mushrooms, and finally search the forest for magic mushrooms. We know this story line is backwards not because we have read every fairy tale in existence and know that this story line does not belong to any of them, but because in reading a select few fairy tales we were able to extract the most important elements behind the interaction of story subplots. Propp set to paper the previously unconsidered structure of the fairy tale and demonstrated how complicated stories can be reduced to a concise syntax. He pioneered a method of analysis of the fairy tale by creating a universal grammar.

The grammar Propp created describes a fairy tale's plot as a series of components. Components are generic portions of the story that advance the plot in a specific way independently of the characters involved. For example, compare the following two events:

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Two children are told by their parents to go into the forest ("Hansel and Gretel") and a girl is told by her mother to go to Grandma's house ("Little Red Riding Hood"). Both events are the same component, "interdiction" as Propp calls it. Both stories can be described as a sequence of components. The result of Propp's efforts was what he calls a tale's morphology: "a description of the tale according to its component parts and the relationship of these components to each other and to the whole."

Propp makes two interesting assertions that define the scope and possible depth of a fairy tale:

1. There are a finite number of functions with a finite number of ways that they interact.
2. For each fairy tale, there is one and only one functional description of the story.

It is generally viewed as impossible that a computer can create a plot, but Propp's methodology gives hope to the idea of fairy-tale-authoring computers.

Propp defines the 31 functions of the characters and describes them and their interactions. They include, for example, such components as *absentation* ("One of the members of the family absents himself from home"), *reconnaissance* ("The villain makes an attempt at reconnaissance [meeting the protagonist]"), *pursuit* ("The hero is pursued"), and *transfiguration* ("The hero is given a new appearance"). The descriptions are not always literal; for example, transfiguration could mean that the hero builds a palace with his newfound wealth.

From Morphology to Fairy Tale

To create a fairy tale from a morphology, a random ordered list of components that logically follow each other must be chosen. This will generate a functional skeleton. To create the plot from the skeleton, the functions must be elaborated, along with the actions of the characters within the functions. This will generate a plot. To create the story from the plot, the expanded functional formula must be translated to natural language (English), which is easier said than done! For a computer to produce a valid fairy tale, it would have to perform all these steps. It is generally viewed as impossible that a computer can create a plot, but Propp's methodology gives hope to the idea of fairy-tale-authoring computers.

In creating the morphology of the fairy tale, Propp anticipated what may be the future of thinking digital computers. A computer programmed to create stories based on the morphological functions could generate the plot skeletons of fairy tales ranging from those of the Grimm brothers to the *Arabian Nights*. It could also create stories never conceived of by any human that ever lived. Like the periodic table of Mendeleev, Propp's morphology finds a mysterious unity among seemingly dissimilar stories and identifies the logical gaps where there is a possible story that does not yet exist. ■

Currently a freshman at Harvard University, Joseph Turian enjoys breaking into his own computer system and writing short stories. He hopes someday to finish his stories and getting in time to go to sleep at a sane hour.

Once Upon a Time ... In the Future

Wonder what an AI-generated fairy tale might look like? Here's a sample plot skeleton, written in the program's syntax. While this story probably won't start a publishers' bidding war, just wait a few years. Computer-written formulaic stories aren't far off.

Abbreviations:
MC=main character
OC=Other character
VL=villain.

START

MC leaves home for a short time
MC is given an interdiction
MC violates the interdiction
VL enters
VL tries to find out information from MC using magic
VL finds out information from MC
VL tries to trick MC
MC succumbs to VL's deceit
MC lacks something
OC forces MC to agree to counteraction
MC departs
MC encounters VL
MC and VL struggle
MC is branded
MC loses the struggle with VL
MC returns home
MC is pursued
MC is rescued from pursuit
VL is punished

END

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Exploring Career Options:
Astronomy

Interview with Luis Ho

by Eileen Prak

Dr. Luis Ho, an astronomer at the Center for Astrophysics at Harvard University, received his Ph.D. in astronomy from the University of California-Berkeley. In August 1998, he will join the staff at The Observatories of the Carnegie Institution in Pasadena, California. In this interview, Dr. Ho tells us about his search for black holes and for a stronger understanding of our place in the universe.

What do you do as an astronomer?

In general, astronomers try to determine the origin and nature of our universe. I study galaxies and black holes within galaxies. My interests center on how galaxies form, how they evolve, and why some galaxies contain black holes in their centers.

What are galaxies and black holes?

Galaxies are the main building blocks of the visible universe. They are each composed of approximately 100 billion stars bound together by their mutual gravitational attraction. Some galaxies have in their centers a very massive object known as a black hole.

The term "black hole" is a bit of a misnomer; it isn't a hole at all. It is an object whose gravitational pull is so strong that matter and light cannot escape. One type of black hole is formed from a star that collapses when its fuel runs out. Normally, the heat generated by the burning of a star's fuel provides a pressure out from the center of the star, which counteracts the inward pressure from gravity. If the fuel runs out, the star, if sufficiently massive, can collapse under its own weight.

Supermassive black holes in the centers of galaxies—the type I am studying—are formed in a very different way. We have several theories about how they might be formed, but we're not yet sure which is right.

What are some of the theories?

One theory is that supermassive black holes were formed shortly after the Big Bang. When matter was initially expanding, there were some wrinkles in space—uneven clumpings of gas. The biggest clumps might have collapsed in on themselves due to gravity and formed supermassive black holes.

Another idea is that they might have formed from individual stellar black holes—the type I described earlier. The centers of galaxies contain an enormous number of stars packed together in a tiny area. Under these conditions, stellar-sized black holes might merge together into one very massive black hole. They would condense there like heavy liquids settling at the bottom of a cup.

How do you detect a black hole?

Although black holes are, by definition, invisible, you can pinpoint them by trying to detect their gravitational influence on objects in their vicinity. Just as we could infer the presence and the mass of the sun, even if it were unseen, by tracing the orbits of the planets, we can deduce the existence of black holes by carefully measuring the motions of stars and interstellar gas clouds whirling around them.

What kind of data do you use?

I use data from many different telescopes around the world (Hawaii, New Mexico, Chile) and in space (the Hubble Space Telescope) to collect radiation from different parts of the electromagnetic spectrum, which ranges from radio waves to visible and ultraviolet light to X-rays. These data are used to determine the physical make-up and inner workings of the central regions of galaxies.

Have you always been interested in astronomy?

Well, I've always been interested in the "big questions." In high school I really loved cell biology. I participated in many science fairs, tinkered with just about anything that could be grown in my bedroom, and sought out various enrichment programs at universities during the summer.

As an undergrad at Harvard, I became more interested in wider philosophical issues: I was engrossed with philosophy, especially topics that attempted to address human nature and our place in the universe. I stumbled upon astronomy one day during my sophomore year at an informal seminar. I was convinced that I had finally found the grandest of the sciences, the noblest of pursuits.

You seem to be just as enamored of astronomy now as you were in college.

It is such an exciting field. Although it is an ancient science, it's also a very new field. Because so much is still unknown and progress is so rapid, I was confident that one person could make meaningful, lasting contributions to the field.

On one of the many nights I spent at Lick Observatory on Mt. Hamilton, near San José in California, I went outside my dome to inspect the weather. That night the air was exceptionally calm, the sky perfectly clear. Out in the distance stretched San José, enveloped in a canopy of orange glow emanating from the city's sodium lights. For the first time I realized how beautiful it was to hear absolute silence. The whole world was asleep—everybody except me. And I realized that I was in control of this mighty telescope. I can point it to any star, any

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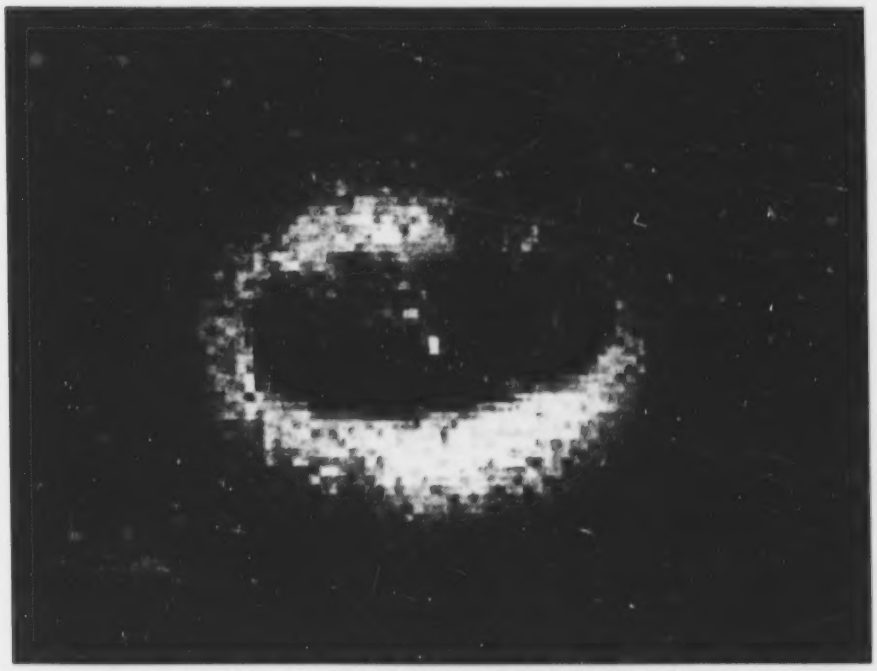


This picture of the center of nearby galaxy NGC 4261, taken by Hubble Space Telescope, shows a dark disk of gas and dust swirling around a massive black hole. Astronomers believe the disk is what remains of a galaxy that fell in or collided with the black hole hundreds of millions of years ago.

Courtesy of NASA, Hubble Space Telescope, H. Ford and L. Ferrarese of Johns Hopkins, and W. Jaffe of Leiden University

galaxy I want. I can use it to peer into the outer reaches of the cosmos and ask all the big questions. What a wonderful privilege this is, I thought, and I still think so.

What did you study in college to prepare for your career?

I earned joint degrees in astronomy and physics. Astronomy requires a solid background in physics and mathematics. It is impossible to do serious research in astronomy without a thorough understanding of physics. Since I was taking so many physics courses anyway, I took a few extra to fulfill the requirements of the physics curriculum. Because I double-majored, I developed a broader understanding of electromagnetism, gravity theory, and classical and quantum mechanics, which were invaluable supplements to my studies in astronomy.

Did you get a chance to do any research while you were an undergraduate?

Yes, I was fortunate to have good mentors in college, and I took advantage of all the opportunities that came my way. By volunteering most of my free time at the university's observatory, I was able to work on research projects very early on. My most concentrated effort was to study the center of our own galaxy, the Milky Way, which we now know houses a supermassive black hole with a mass three million times that of the sun.

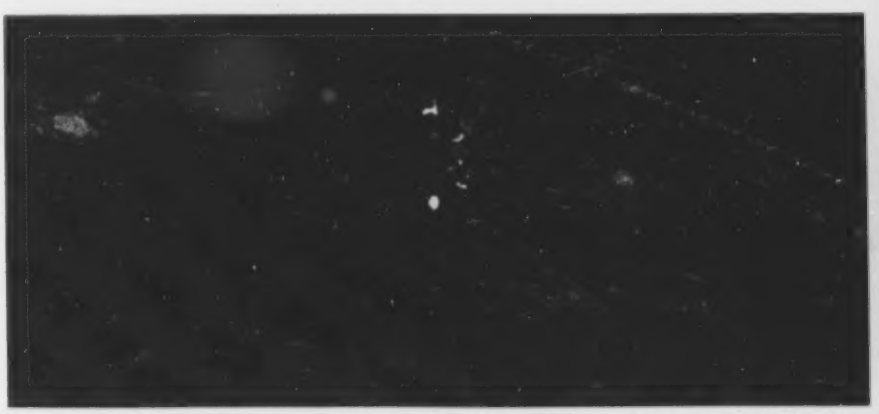
What projects are you working on now?

I am using the Hubble Space Telescope to image the centers of nearby galaxies and observe the effect that black holes have on their surroundings. I am also very interested in the starburst phenomenon, in which very large numbers of stars form over a short period of time in neighboring galaxies. Cosmic firecrackers, if you will.

What do you see as the most rewarding aspect of your career in astronomy?

There are many aspects that are very satisfying, but perhaps the most rewarding is my complete independence in my work. One of the greatest satisfactions related to this independence is that I can honestly say that I've never really wanted to take a vacation! To me, there is no distinction between my activities at work and outside of work. My study of astronomy isn't limited to my office—it follows me home. Often I have dinner with it; I sleep with it; I dream about it; I wake up with it. Sometimes I am so engrossed with a particular problem that it stays on my mind for days on end.

I also travel quite a bit—sometimes to very remote parts of the world—to collect data and attend conferences. I just spent two weeks in Japan, and I'm going to India



At the center of our galaxy lie young stars, dust clouds, swirling rings of gas, and a supermassive black hole. This photo of the center of the Milky Way was taken by the SPIRIT III telescope in infrared light, because intervening dust and gas would obscure our view in the visible wavelengths.

Courtesy of S. Price et al., of Philips Lab, CBE, MSX, and the US Air Force

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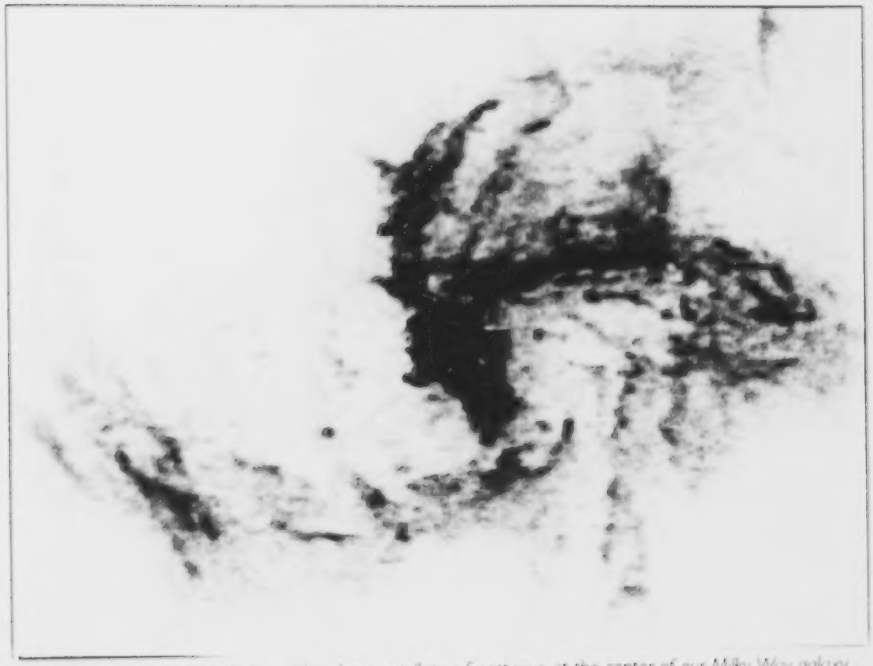

A supermassive black hole lies within the constellation Sagittarius at the center of our Milky Way galaxy. This image, taken at radio wavelengths, shows gas spiraling into the black hole.

Courtesy of F. Yusef-Zadeh of Northwestern University.

shortly to attend a month-long workshop on black holes.

As much as I love what I do, I also feel I have a tremendous responsibility to society. Scientists have an obligation to the public at large: to inform, to educate, and to inspire.

What do you think is the most exciting facet of astronomy?

The fact that the whole field is making advances at a dizzying pace. We are fortunate to be living in an era of technological explosion, and as a result, telescopes that are more powerful than ever are sprouting up across the globe, and others are being prepared to be launched into space. In this way, the oldest of the sciences continues to renew itself.

Selected Resources

Ferris, Timothy. *Coming of Age in the Milky Way.* New York: Anchor Books, 1989.

Gribbin, John R. *Unveiling the Edge of Time: Black Holes, White Holes, Worm Holes.* New York: Crown Trade Paperbacks, 1994.

Hawkins, Michael. *Hunting Down the Universe: The Missing Mass, Primordial Black Holes, and Other Dark Matter.* Reading: Addison-Wesley, 1997.

Longair, Malcolm. *Alice and the Space Telescope.* Baltimore: The Johns Hopkins University Press, 1989.

were once condemned are now considered acceptable.

For example, you're not likely to hear "It is I" or "For whom is it?" on television. Even though the phrases "It is me" and "Who is it for?" are grammatically incorrect, they are largely accepted today. Rules that prohibit ending sentences with prepositions and splitting infinitives have been also loosened somewhat. As Jonathan Freeman notes in the interview on page 11, no one would ever say, "Your behavior is something up with which I will not put."

E.B. White, in his addition to William Strunk's *The Elements of Style*, notes that you can use your ear to make good judgements. But first you'll need to grab a grammar guide and learn the correct way to write and speak. As White said, you must know the rules of grammar before you can violate them successfully because "only a writer whose ear is reliable is in a position to use bad grammar deliberately."

Selected Resources

Gordon, Karen Elizabeth. ***The Deluxe Transitive Vampire: The Ultimate Handbook for the Innocent, the Eager, and the Doomed.*** New York: Pantheon, 1993.

O'Conner, Patricia T. ***Woe is I: The Grammarphobe's Guide to Better English in Plain English.*** New York: Putnam, 1996.

Related Web Sites

Common Errors in English
www.wsu.edu:8080/~brians/errors/index.html

Grammar and Style Notes
www.english.upenn.edu/~jlynch/grammar.html

Online Writing Lab
www.english.purdue.edu

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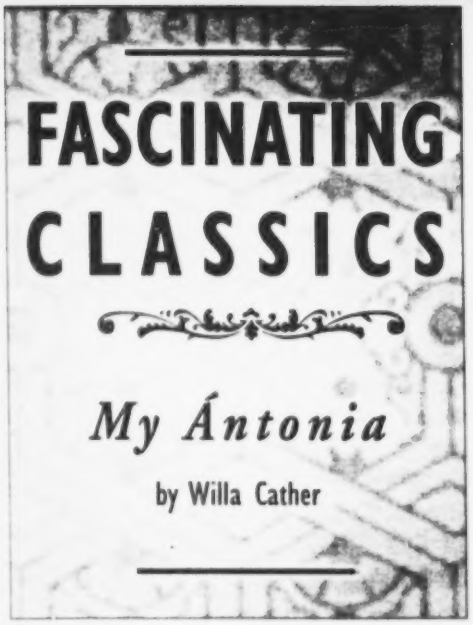
FASCINATING CLASSICS



Review by
Lesley Mackay & Kimberly Nolan

Lesley: American literature is full of immigration stories, from tales of colonial war, such as James Fenimore Cooper's *The Last of the Mohicans,* to contemporary accounts of immigrant life, such as *The Joy Luck Club.* The story of navigating an unfamiliar and somewhat hostile environment is the human story magnified: we all must cope with the unknown and, at least from time to time, with adversity.

Willa Cather's 1918 novel, *My Ántonia,* describes the coming-of-age of a young city girl from Bohemia, Eastern Europe, as she courageously masters life on the Nebraskan plain. Ántonia Shimerda's heroic story is told by Jim Burden, an orphan who lives on his grandparents' farm, which neighbors the Shimerdas' squalid earthen dugout.

Kimberly: The novel is set in Nebraska, but Jim and Ántonia meet before they set foot in that state, on a train trip across the country. Jim, 10, has just lost his parents and left his native Virginia to be united with his grandparents. Ántonia, 14, has just come "across the water" with her family in search of opportunity on a new continent. The land that Jim and the Shimerdas finally encounter is stark and unpopulated; Jim describes it as "not a country at all, but the material out of which countries are made."

By having Jim and Ántonia voyage out West together, Cather establishes their intertwining, both in life and in their story. Jim is the narrator and principal male character, but his presence in the novel is far from overbearing. Jim depicts himself as living vicariously through others, especially Ántonia, and he reveals that *his* coming-of-age was powerfully shaped by the more dramatic characters around him.

Lesley: I agree, Kimberly. Although Jim lacks Ántonia's striking presence, he pervades every page of Cather's book. Reading the novel, I was also struck by some more basic differences between the two young people. Jim's family runs a successful farm, while Ántonia's struggles to survive. He attends school and then Harvard, while she speaks broken English and works in the fields or in other people's homes. His grandparents are confident, successful farmers, while her father, a violinist, is undone by the plains, and her mother is embittered by hardship.

Kimberly: Yes, Jim and Ántonia come from two seemingly alien worlds. Yet they share a sense of loyalty and an appreciation of their rural environment and the values it inspires. Through these common traits, the two form a lasting connection.

Lesley: Their ability to surpass their differences is illustrated early in the novel. In one scene, Jim, his grandmother, and a hired hand visit the Shimerdas for the first time, finding them bewildered and hungry. However, Jim, Ántonia, and her little sister exuberantly run out that morning to play:

> *We raced off toward Squaw Creek and did not stop until the ground itself stopped—fell away before us so abruptly that the next step would have been out into the tree-tops. We stood panting on the edge of the ravine, looking down at the trees and bushes that grew below us. The wind was so strong that I had to hold my hat on, and the girls' skirts were blown out before them. Ántonia seemed to like it; she held her little sister by the hand and chattered away in that language which seemed to me spoken so much more rapidly than mine. She looked at me, her eyes fairly blazing with things she could not say.*

From the first pages of the book, Ántonia is shown to be inspired by the magnificent Nebraska landscape. Her affinity for the plains and Jim's appreciation of her earthiness provide the basic texture of the novel.

Kimberly: And Ántonia's love for the land generates the novel's essential drama: achieving transcendence through work. Work, especially the work of women, is held in high regard throughout *My Ántonia.* Cather introduces several industrious female characters, from the busily domestic Mrs. Burden, Jim's grandmother, to the immigrant girls who work in Black Hawk, to established career women who manage family businesses or start their own successful enterprises.

While all of the novel's women are important to Jim, Ántonia stands as his powerful prototype for the working woman. As a young girl, she hires herself out as a laborer at neighboring farms, joining her brother Ambrosch in the threshing and harvesting that her father is too delicate to do. Then, in her late teenage years, she accepts employment as a domestic servant in the small town of Black Hawk, where she refines her housekeeping skills, learns the ways of society,

Willa Cather: Writer of the American Plains

What inspired Willa Cather to create a set of highly individualistic and independent female characters like the radiant, self-assured, and hard-working Ántonia Shimerda? Why, her own life, of course.

Born in 1874 in Virginia, Cather, like Jim Burden, was transported to Nebraska as a child. Bold and outspoken, the young girl tussled with her gender, cutting off her hair, wearing androgynous clothing, and signing her name on occasion as "William." Brainy and inquisitive, she chose adult companions and anticipated a fabulous career as a surgeon.

Upon finishing high school, Cather insisted on going to college, a path not typically taken by the young women of her day. She entered the University of Nebraska in Lincoln intending to study medicine. However, after an English professor sent one of her freshman essays to Lincoln's most widely read newspaper and it was published, she decided to become a writer. Prolific from the start, Cather penned half a million words of criticism for the *State Journal* while completing her undergraduate work.

After college, Cather's path toward literary fulfillment was

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and at times rejects those ways. Not surprisingly, she one day returns to the plains.

Lesley: Ántonia's acceptance of a life of labor creates a rift between her and Jim. After she turns 15, he asks her to consider attending school, and she offers him a complex reply:

> *"I ain't got time to learn. I can work like mans now. My mother can't say no more how Ambrosch do all and nobody to help him. I can work as much as him. School is all right for little boys. I help make this land one good farm."*
>
> *She clucked to her team and started for the barn. I walked beside her, feeling vexed. Was she going to grow up boastful like her mother, I wondered? Before we reached the stable, I felt something tense in her silence, and glancing up I saw that she was crying. She turned her face from me and looked off at the red streak of dying light, over the dark prairie.*

Kimberly: Jim's reflections on this moment provide several insights. Jim reacts more to Ántonia's description of him as a boy than to her rejection of schooling. In his indignation, he mistakes her stoicism for pride. Ántonia seems quite certain that she is making the right decision in passing up the opportunity to study. Yet Jim notices, but perhaps does not understand, a poignant sign of her recognition that she has suffered a loss.

Lesley: Jim isn't always sensitive to Ántonia's losses. And, like his grandparents and their hired men, he sometimes seems indifferent to the troubles that afflict the immigrant families and a little judgmental of their different cultural ways. This bothered me on occasion as I read the novel.

Kimberly: More positively, though, the Burdens exhibit the self-reliance that is an important, evolving theme in the novel. *My Ántonia* expresses that the prairie will break those who cannot survive without assistance—this is an impersonal process of nature, not a phenomenon that derives from human prejudice. Mr. and Mrs. Shimerda fail to hold their own on the plain, so the task of ensuring family survival falls to their children.

Lesley: I think you're right, Kimberly. It's valuable to look at the novel as a product of its own era and that era's tough realities. For example, *My Ántonia* affirms that female children bear a responsibility to support their families. Cather not only shows Ántonia laboring in the fields, but also, in the later section "The Hired Girls," shows several young immigrant women working in town to earn money for their parents and siblings. The girls' dedication to their families exemplifies the reality principle that dominates the novel: Circumstances cannot be ignored; burdens must be shouldered. Nonetheless, the girls' dedication brings them unforeseen personal rewards. Jim remarks that they

> *. . . had grown up in the first bitter-hard times, and had got little schooling themselves. But the younger brothers and sisters, for whom they had made such sacrifices and who have had "advantages," never seem to me, when I meet them now, half as interesting or well educated. The older girls, who helped to break up the wild sod, learned so much from life, from poverty, from their mothers and grandmothers; they had all, like Ántonia, been early awakened and made observant by coming at a tender age from an old country to a new.*

Kimberly: Through Jim's observations, I think that Cather redefines the roles of girls and women and creates a startling vision of what they are able to achieve. Lena Lingard, Tiny Soderball, the two Bohemian Marys, and Ántonia—none of them depends on a man for support nor relies on that future possibility. Neither Lena nor Tiny marries; both become successful businesswomen and entrepreneurs. And although Ántonia marries and has 11 children, she also assumes leadership in running the family farm with her husband; the novel's final section clearly indicates that she has taught him how to get the most from the land.

Lesley: Jim constantly reaffirms his admiration for these female characters. It almost seems odd that he doesn't marry one of them. In the end, though, he seems to judge them as unsuitable for marriage to a Harvard-educated lawyer.

Kimberly: I know what you mean, Lesley. It originally struck me as one of the novel's shortcomings that Cather did not further integrate the adult lives of Jim and the immigrant women. Instead, she concludes her book with Jim and Ántonia briefly reuniting after a 20-year separation. Sensing that something is missing in his life, that he has perhaps made some unfortunate choices, Jim relocates Ántonia and, in so doing, seems both to find and to complete himself. The warmth of childhood radiates through his final reflections:

> *I had the sense of coming home to myself. . . . For Ántonia and for me, this had been the road of Destiny; had taken us to those early accidents of fortune which predetermined for us all that we can ever be. Now I understood that the same road was to bring us together again. Whatever we had missed, we possessed together the precious, incommunicable past.* ■

long and not entirely smooth: she published her first novel at 38 after years of writing for newspapers and magazines. She crafted some short stories during her years of news-writing—stories that reflect her admiration for the works of Henry James. Cather never gave up the mood of exile and elegy that she inherited from James, but when she began setting novels in the prairie communities of the American West, she assumed her own unique voice.

Before her death in 1947, Willa Cather wrote several novels, works that were lauded and rejected and lauded again for their portraits of ordinary people visited by transcendent emotions in landscapes of remote beauty and awesome power.

Upcoming Fascinating Classics:

John Steinbeck, *The Grapes of Wrath*
Virginia Woolf, *To the Lighthouse*
Ernest Hemingway, *The Old Man and the Sea*

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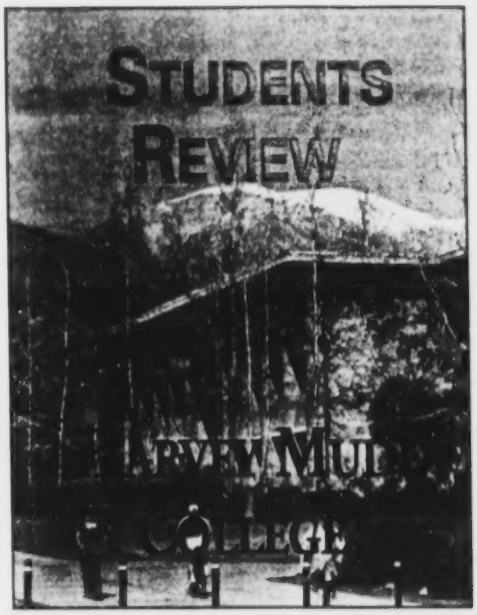
The College Review Series is intended to aid prospective college students in their search by offering insiders' views of selected colleges and universities, as expressed by current undergraduates or recent graduates who have high academic ability. Note that the number of reviewers is small. Consider their personal perspectives as only one component as you gather information and impressions from many sources.

Our reviewers include fifteen students, who major(ed) in biology (3), classics* (1), chemistry (3), economics* (1), engineering (2), literature* (1), math (9), and physics (2). (The number of majors exceeds fifteen because seven reviewers completed two majors.) Majors marked with an asterisk were completed at one of the other Claremont Colleges.



Quality of Academic Instruction for Undergraduates

For students who want a first-rate technical education, a small-college environment, and access to excellent liberal arts courses, Harvey Mudd offers a unique opportunity. It's one of the Claremont Colleges, an educational consortium of five adjoining schools, each with a different emphasis. Offering only six majors—biology, chemistry, computer science, engineering, math, and physics—Mudd has one of the best reputations in the nation for educating top math, science, and engineering students.

"Undergraduate education at Mudd is superb. The professors are generally the best that can be found anywhere, a fact that became quite clear to me once I began graduate school. I had come to take for granted a level of teaching ability and dedication to students that is extremely rare. Since Mudd is part of the Claremont Colleges, a vast selection of high-quality professors can be found in all subject areas—and all within a five-minute bike ride."

"The quality of instruction is incredibly high. Mudd has only undergraduates, so faculty concentrate on teaching more than on research. Profs are extremely accessible and strongly committed to creating a challenging, rewarding undergraduate environment. In addition to all that Mudd offers in math and science, students can draw upon the academic resources of the other Claremont Colleges for breadth."

"With only 150–170 students per graduating class, Mudd provides an intimate learning environment. Freshman chemistry and physics lectures include the entire freshman class, but labs and recitation sections have no more than 20 students. Most other classes range from 15–40 students; some upper-level classes have only two or three students. Grading is tough but fair."

"The heart of a Harvey Mudd education is the rigorous Core curriculum, which provides a strong and broad science background: four semesters of math, three of physics (plus two of physics lab), two of chemistry (plus two of chem lab), and one each of biology, computer programming, and systems engineering. For the first three semesters, all students take roughly the same courses, ensuring that everyone has a basic understanding of most science before specializing. The Core is extremely coherent; I often found myself making connections between topics being covered in completely different classes. Mudd students are also required to take twelve humanities courses—an unusually large number for a science school."

"The first three semesters are one colossal shared experience, giving everyone the sense of surviving a challenging rite of passage together. Staying awake until two in the morning doing frosh chem problem sets may be miserable, but enduring bonds are forged in those late-night problem sessions."

"If broad swaths of science have the power to enthrall you, the Core is a great thing, but it's not for everyone. It affords students little freedom of choice during the first three semesters; you can't really avail yourself of the breadth of offerings at the other Claremont Colleges until your final two years."

"The Core is a very big deal at Mudd. We complain about it, but because of it, we are truly well-rounded scientists. It prepares us to do interdisciplinary work and to perceive interdisciplinary connections—to be the prepared minds favored by chance."

"The course load is heavy. Mudd students must average five courses plus labs per semester in order to graduate. Six courses is not considered an overload. In contrast, students at the other Claremont Colleges average a four-course load. The attitude is very much in favor of biting off more than you can chew, then dropping a course or two if need be; but many ride it out."

"Mudd's Honor Code is taken very seriously. The trust it engenders between students and faculty makes it possible for professors to assign timed, closed-book, take-home exams which students can complete at a time and location convenient for them."

"Because of the five-college consortium, we have access to resources that would normally be found only at a much larger school. The most essential resources are right on campus, including the main science library for the five colleges and Mudd's computing facilities."

Social Life

Reviewers spoke warmly of the social life.

"Students here tend to be individualistic and creative; being around such people is inspiring. Extracurricular life is amazingly lively given the amount of work we subject ourselves to. All the standard activities are available—chorus groups, theater, film, dorm events, ethnic organizations, religious life. Some groups, like the unicyclists and jugglers, are distinctive to Mudd, while others draw from all five colleges."

"Almost all students live on campus, creating a very strong sense of community. Everyone looks out for each other in a caring but not intrusive way. Informal social opportunities abound; at any hour, you can find something interesting going on just by wandering around the residential part of campus. Many students take advantage of the southern California climate and frequently

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leave their doors open, contributing to an overall friendly atmosphere in the dorms."

"Mudders tend to have a slightly warped sense of humor. We're sometimes described as the geek school of the five colleges, but we think this is just because **they** *don't understand our jokes! We also have a tradition of non-malicious pranks. Displays of creative exuberance provide a good way to release the stress that comes with having to do so much work."*

"The other Claremont colleges provide a good mix of people and activities. There's always something to do on campus—if you have the time. Plays, concerts, movies, and five-college parties and events occur frequently, while all sorts of sports activities and facilities can be found at Claremont McKenna College, a five-minute walk."

"The 3:1 male-to-female ratio can be a bit frustrating, but taking courses at the other colleges and making an effort to meet people on the other campuses can alleviate this strain."

"Claremont is 45 minutes from downtown Los Angeles, Hollywood, beaches, and skiing in the winter. There's great rock-climbing less than two hours away in the desert, and biking trails are everywhere. Claremont itself is a very safe little suburb, if a tad boring."

What Do You Like Best about Mudd?

Reviewers appreciated the school's challenging yet strongly supportive environment.

"The learning is intense, but the pride you feel after completing a semester is immense. The support network is also extraordinary. Nobody wants you to fail—there is no intentional weeding out. Tutors and friends are everywhere, and professors' doors are always open."

"Mudd brings together hundreds of excellent people and provides them with great opportunities. Senior year, I took six courses each semester, acted in three plays, wrote an English thesis through Scripps College, and completed a math project. I was busy every moment of the day, yet was energized and happy because I thoroughly enjoyed it all."

"The Honor Code permeates all aspects of Mudd life, and we uphold it devotedly. The professors trust us, and the students trust each other. We can expect certain levels of conduct from people we've never met simply because they are Mudders. The openness this leads to is remarkable."

What Do You Like Least about Mudd?

The air pollution and the strain of the academic demands were the major complaints.

"Claremont has some of the worst air quality in the nation during the summer, and spring and fall have many bad days. The prevailing winds collect all the smog from the Los Angeles basin and funnel it along the San Gabriel mountains just north of Mudd. It's not fun for anyone, let alone people with asthma or allergies."

"Mudd is tiring. After countless all-nighters and years of overloading on courses, I was pretty worn out. I learned a tremendous amount, but I just wasn't ready to attack grad school with the same level of dedication after working to my limits for four years at Mudd."

"Mudd is a very demanding place, both academically and personally. It's entirely possible to enjoy and even love Mudd despite this; I do. But anyone prone to health problems—physical or mental—may find them aggravated here."

HARVEY MUDD COLLEGE

Claremont, CA 91711
(909) 621-8011

- **4-year private coed college.**
- **Suburban campus 30 miles east of Los Angeles.**
- **Full-time undergraduate enrollment 1997–98: 494 men; 158 women.**
- **Special features: Member of a five-college consortium, the Claremont Colleges. The other colleges are Pomona, Pitzer, Claremont McKenna, and Scripps Colleges.**

Who Would Be Most Compatible with the Academic and Social Atmosphere at Mudd?

"The average Mudder is brilliant, honest, down-to-earth, warped (in terms of sense of humor), and willing to work on homework every night until 1 a.m. We watch **The Simpsons** *religiously and are more apt to fight over Mac versus PC than Republican versus Democrat. We often discuss physics over breakfast and have been known to pull brilliant practical jokes on our rival school in Pasadena."*

"Someone who is completely committed to studying science or engineering—because there's nothing else to major in—but who also enjoys humanities, which make up a significant portion of the graduation requirements. Anyone interested in science alone probably isn't as suited to the Mudd culture, which is enriched by the broad interests of the students and faculty."

If You Had It to Do Over Again, Would You Go to Mudd?

All but one reviewer enthusiastically said yes.

"Absolutely. Having four years of personal attention from brilliant, caring professors during those critical undergraduate years was invaluable. I got the best education I could have gotten and met more outstanding people than I have at any other time or place."

"Undoubtedly. Despite the stress, I love the feeling of being challenged to the limits of my ability. I love the people—brilliant, eclectic, talented, compassionate, fascinating. Here I am finally free to be the person I was at CTY but could never be in my hometown."

"Yes! The only thing I'd do differently would be to accept the offer immediately. Going to Mudd was the best decision I ever made, period."

"No. Mudd's focused curriculum didn't give me enough latitude to change my mind—which I did. I decided (too late to transfer) to major in economics. I was able to do so at another Claremont College, but I had to complete a minor in biology to graduate from Mudd."

As you try to find the college or university best suited to you, the views presented above may be helpful. Keep in mind that these students might have had similar positive or negative experiences had they attended a different school. At any college, it is important to seek out challenging academic experiences and to create a social life that fits your personal style. ■

Note: The students quoted in the College Review Series are expressing their own views which are not necessarily those of JHU or CTY.

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PLANNING AHEAD FOR COLLEGE

High School Extracurricular Activities

by Linda E. Brody, Ed.D.

Savvy students know that good grades and test scores aren't enough to gain admission to a highly selective college or university. Colleges also seek students who have excelled in extracurricular activities. Thus, students who are worried about college admissions often frantically join any groups they can during their last year or two of high school. But you aren't likely to fool admissions officers by padding your résumé. As Paul White, Director of Undergraduate Admissions at Johns Hopkins, said in an interview that appeared in the September/October 1996 issue of *Imagine*:

> *[At Hopkins] we're looking for students who have shown a sustained commitment to their interests, both academically and extracurricularly.... So don't show me a laundry list of activities where you've hopped around so much I can't really get a sense of who you are. And don't give me one that suddenly expands when you're in twelfth grade, because I'll know you're only doing those things because you feel you have to.*

Why are colleges interested in activities, anyway? Why aren't grades and test scores enough? Colleges that have more highly qualified applicants than they can admit seek academic high achievers who have also demonstrated an eagerness to challenge themselves beyond the high school curriculum. They look for people who will bring their interests to college and join campus or community activities. They want students who have shown initiative and commitment and who have developed good interpersonal and leadership skills.

Choosing Activities

Which activities should you join? And how many? Although there are no clear right or wrong answers to these questions, these guidelines might help.

- *Explore your interests early; then focus on developing one or two strong interests.* Middle school is a time to investigate new opportunities. Get involved in a variety of activities. When you've identified the type of activity you find most satisfying, seek a number of ways to become more involved in that area. As you move through high school, the number of areas you participate in should diminish as your involvement in one or two increases substantially.
- *Don't limit your choices to school-based activities.* You can become involved in anything that helps you develop a skill and grow as a person. You might enjoy school activities such as sports, writing for the newspaper, or student government; an independent hobby such as scuba diving, poetry writing, or wood working; or religious activities, community service, or a paid job. Plan your summers wisely to include endeavors that enhance your learning, whether you're in a classroom or an office, at home or traveling to another country. Ideally, consider in- and out-of-school activities that complement each other. So if math is your thing, don't limit yourself to joining the school math team. You can also take the American High School Math Exam, work with a tutor on a math project for the Westinghouse Science Talent Search, and maybe tutor disadvantaged kids in math. If your interests lie in politics, join the student government. But also volunteer in a political campaign, do an internship for a state senator, and work to improve something in your community. Becoming involved in more than one activity shows that your interest in an area is genuine.
- *Pursue opportunities for leadership and recognition.* Once you've decided to commit yourself to one or two areas, strive to achieve distinction. Seek a variety of ways to become involved, and work for prizes, awards, and positions of responsibility.

When It's Time to Apply

As you list activities on your college application, group together those that complement each other so your strong interest is apparent; also be sure to include honors, leadership positions, and other indices of high achievement. If your list doesn't adequately portray the degree of your involvement, you can also do one or more of the following:

- *Write your application essay about your area of interest.* Describe what you've learned from your involvement and how it's made you a better person. Relate this knowledge and growth to your plans for the future.
- *Seek a recommendation from someone familiar with your extracurricular activities.* If a teacher knows about both your academic and extracurricular work, ask for a recommendation that encompasses both areas. If appropriate, a recommendation from someone outside of school who is familiar with your efforts may be sent with your application.
- *Submit products of your work.* Demonstrations of talent that cannot be shown in other ways on your college application, such as poems, an original math proof, or a tape of a musical performance, are appropriate supplements to your college application. But keep them short because admissions officers are limited in the amount of time they can spend on one student's application.

Activities are an important part of your high school experience—and not just for the purpose of getting into college. They extend your learning beyond the classroom, so choose them as carefully as you do your courses. And work to excel in them, just as you do in your courses. The colleges to which you apply are likely to be impressed by your efforts and accomplishments in all areas. ■

If you're planning for college ...

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THE COACH'S CORNER

by Chengde Feng

Mr. Feng teaches mathematics at the Oklahoma School of Science and Mathematics (OSSM) and has coached many students who have competed successfully in mathematics contests in China and the U.S. In this column, Mr. Feng offers Imagine readers questions designed to improve their problem-solving skills.

1. Find the value of k such that $6x^2 - 5xy - 4y^2 - 11x + 22y + k$ can be factored into two linear expressions.

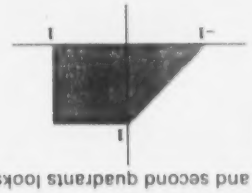
2. Find the area of the region whose points (x,y) satisfy $|x| + |y| + |x - y| \le 2$.

3. f(x) and g(x) are two functions defined on the set of real numbers, satisfying that (I) $f(0) = 0$; (II) $g(x - y) = f(x)f(y) + g(x)g(y)$ for all real numbers x and y. Show that $[f(x)]^{1998} + [g(x)]^{1998} \le 1$.

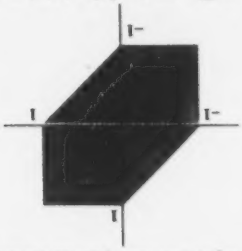
1. Suppose that $6x^2 - 5xy - 4y^2 - 11x + 22y + k = (2x + y + m)(3x - 4y + n)$.
Then $6x^2 - 5xy - 4y^2 - 11x + 22y + k = 6x^2 - 5xy - 4y^2 + (3m + 2n)x + (-4m + n)y + mn$.
Equating coefficients in both sides gives $3m + 2n = -11$, $-4m + n = 22$, and $mn = k$.
Solving the system of equations yields $k = -10$. $(m = -5, n = 2)$

2. Since the region whose points satisfy $|x| + |y| + |x - y| \le 2$ (*) is symmetric with respect to the origin (why?), we consider first the points in the first and second quadrants.

(I) In the first quadrant where $x \ge 0$ and $y \ge 0$, (*) is reduced to
$$\begin{cases} x \le 1, \text{ if } x - y \ge 0 \ (\text{or } x \ge y) \\ y \le 1, \text{ if } x - y \le 0 \ (\text{or } x \le y) \end{cases}$$
(I) (III) $\Rightarrow$ The part of region whose points in the first and second quadrants looks like:



(II) In the second quadrant where $x \le 0$ and $y \ge 0$, (*) takes the form $y - x \le 1$;
By symmetry with respect to the origin, the region whose points satisfy (*) looks like:



$\Rightarrow$ The area of the total region is 3.

3. Proof: Setting $x = y$, then $[f(x)]^2 + [g(x)]^2 = g(0)$.
Substituting $x = 0$: $[f(0)]^2 + [g(0)]^2 = g(0) \Rightarrow [g(0)]^2 = g(0) \Rightarrow g(0) = 0$ or $g(0) = 1$.
If $g(0) = 0$, then $[f(x)]^2 + [g(x)]^2 = 0 \Rightarrow f(x) = g(x) = 0 \Rightarrow [f(x)]^{1998} + [g(x)]^{1998} = 0 \le 1$.
If $g(0) = 1$, then $[f(x)]^2 + [g(x)]^2 = 1 \Rightarrow |f(x)| \le 1$ and $|g(x)| \le 1$
$\Rightarrow [f(x)]^{1998} \le [f(x)]^2$ and $[g(x)]^{1998} \le [g(x)]^2 \Rightarrow [f(x)]^{1998} + [g(x)]^{1998} \le [f(x)]^2 + [g(x)]^2 = 1$.

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CREATIVE MINDS

ImaGiNe...

Remembering Miami

by Adrian Mall

I remember peach buildings pasted
to an inky Florida night
and stars in the sky like light
through moth holes in a lamp shade

and I can still see
blackened gum on sparkling asphalt
red faces passing a neon sign in a bar window
and girls with platinum hair flashing
against iodine tans

I can taste brown sugar crisp
on carne frita at Rodrigo's
and the salty, humid coating on my tongue

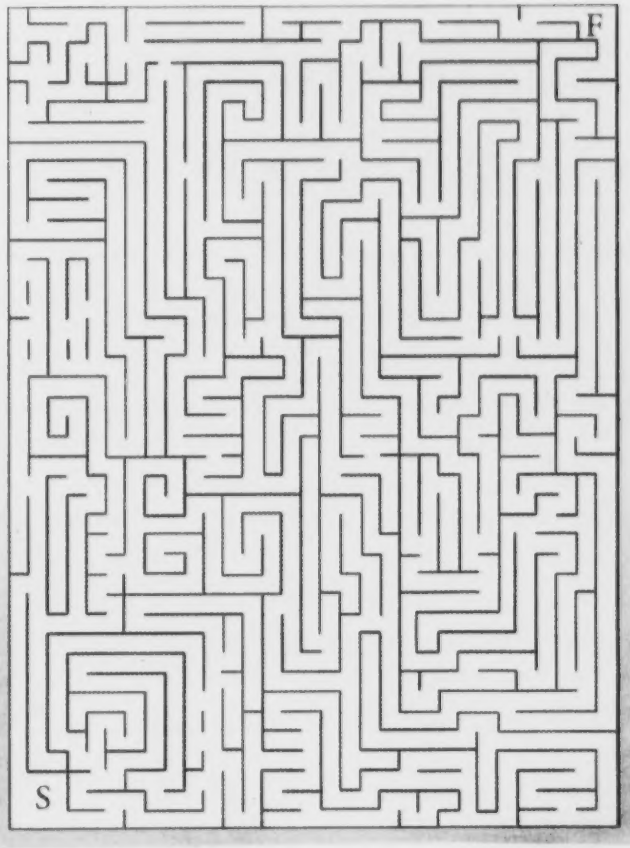
I feel the strong kiss of the sea's spray
the wind leaning on my cheek
a breeze carrying merengue

I still hear the crowd's busy speak
and the applause
of one hundred waves
crashing on the shore

Adrian Mall is a junior at Westmont Hilltop High School in Johnstown, PA. He is active in journalism and the Creative Writing Club and is also interested in photography.

A Maze

by Edward Shen



Edward Shen is a freshman at El Toro High School in Lake Forest, CA, where he is active in Key Club and FBLA. In addition to creating mazes, he's also interested in math and computers.

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YOUR WRITING COULD BE ON THIS PAGE!

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MARK YOUR CALENDAR...

with these registration deadlines for selected academic competitions. Inquire about competition format, dates, and fees.

DEADLINE	COMPETITION
Fall 1997	**JETS-TEAMS Competition, and National Engineering Design Challenge**—Schools register teams for both competitions, grades 9–12; *call for state deadlines:* Junior Engineering Technical Society, 1420 King Street, Suite 405, Alexandria, VA 22314-2794; (703) 548-5387, fax (703) 548-0769; jets@nas.edu; www.asee.org/jets
December 1*	**United States Academic Triathlon**—Schools/organizations register teams, grades 5–12. Enrichment kits available, grades 3–4. *December 1 deadline for existing teams in AZ, KS, MN, NY; new teams in other states may register through May 1: Peggy Sheldon, University of St. Thomas, DUN 234, 52 South 10th Street, Minneapolis, MN 55403; (612) 962-4534, fax (612) 962-4810; plsheldon@stthomas.edu
December 15 or January 15	**American High School Mathematics Exam (AHSME)**—Schools register, grades 9-12; lower fee for earlier date: Dr. Walter E. Mientka, American Mathematics Competitions, Department of Mathematics and Statistics, University of Nebraska, P.O. Box 81606, Lincoln, NE 68588-0658; (800) 527-3690, fax (402) 472-6087; www.unl.edu/amc/
January 1	**ACSL Computer Science Contest**—Schools register teams (no individual students); junior, intermediate, senior divisions: American Computer Science League, P.O. Box 40118, Providence, RI 02940; (401) 822-4312; info@acsl.org; www.acsi.org
January 6	**USA Computing Olympiad**—School Coordinators register grades 9–12; Qualifying Round held late January: Dr. Donald T. Piele, University of Wisconsin-Parkside, Kenosha, WI 53141; (414) 595-2231; usaco.uwp.edu
January 7 or March 11	**Knowledge Master Open-Elementary**—Schools enter one team, grades 5 & 6: Academic Hallmarks, Box 998, Durango, CO 81302; (800) 321-9218; fax (970) 247-0997. *(Grades 7–12 register by April 8.)*
January 10	**National Latin Exam**—Latin teachers register students in Latin I–IV: National Latin Exam, P.O. Box 95, Mount Vernon, VA 22121; format questions, (703) 360-4354; delivery awards questions, (703) 455-6779.
mid-January	**U.S. National Chemistry Olympiad**—Teachers nominate students who have taken high school chemistry; *call for local test dates:* American Chemical Society, 1155 16th Street, NW, Washington, DC 20036; (202) 872-6169; www.acs.org
mid-January	**National Mythology Exam**—Schools register students in grades 7–9. Participants are tested on Greek, Roman, Native American, and African mythology: American Classical League, Miami University, Oxford, OH 45056; (513) 529-7741, fax (513) 529-7742; www.umich.edu/~acleague/
January 14	**Duracell/NSTA Scholarship Competition**—Students enter individual original projects, grades 9–12: National Science Teachers Association, 1840 Wilson Boulevard, Arlington, VA 22201-3000; (888) 255-4242.
January 23	**NCTE Achievement Awards in Writing**—Teachers nominate students in grade 11: National Council of Teachers of English, Achievement Awards in Writing, 1111 W. Kenyon Road, Urbana, IL 61801-1096; (217) 328-3870.
January 28	**National Peace Essay Contest**—Students enter with adult contest coordinator, grades 9–12: United States Institute of Peace, 1550 M Street, NW, Suite 700, Washington, DC 20005-1708; (202) 429-3846; heather_kerr@usip.org
February 3	**Toshiba/NSTA ExploraVision Awards Program**—Teachers and community advisors register student teams, grades K–3, 4–6, 7–9, 10–12: National Science Teachers Association, 1840 Wilson Boulevard, Arlington, VA 22201-3000; (800) EXPLOR-9; www.nsta.org/programs/explora.htm
February 5	**Quill and Scroll Society International Writing and Photography Contest**—Individuals enter, grades 9–12: School of journalism, University of Iowa, Iowa City, IA 52242; (319) 335-5795, fax (319) 335-5210.

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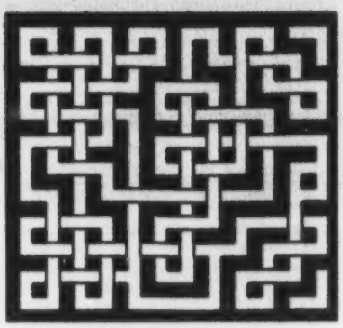


Knossos Games

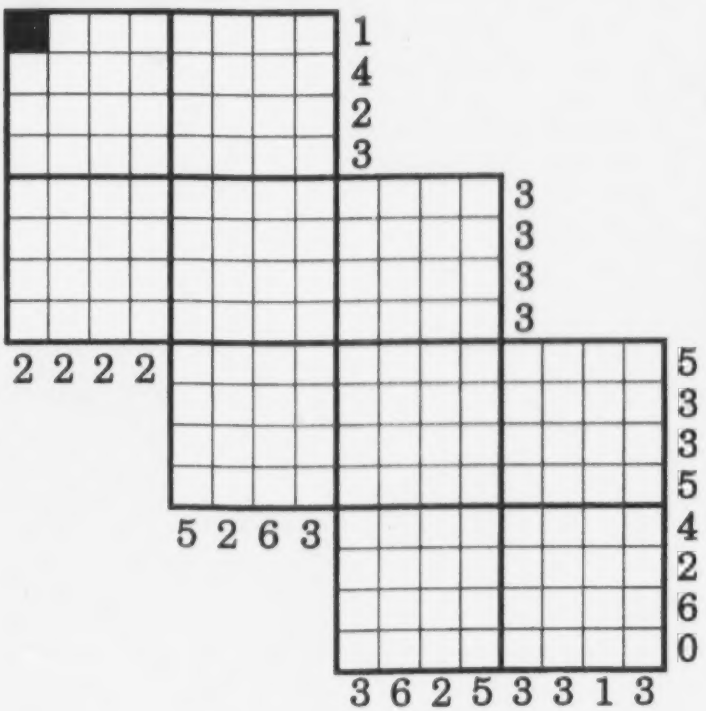
by Tim Boester

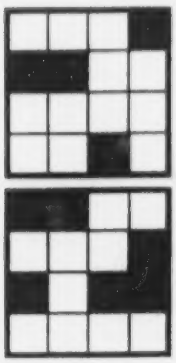
Fascinated by mazes and puzzles, Tim Boester is also intrigued by roller coaster design. Tim is a senior at the University of Chicago where he is studying math.

Directions:

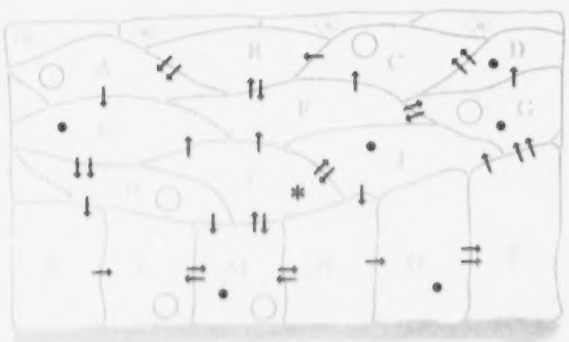
Use the two 4x4 stamps at right to fill in the squares of the larger grid. Each stamp may be rotated 90, 180, and 270 degrees. When the grid is correctly filled in, the total number of black squares in a row or column will equal the number found beside or below that row or column.

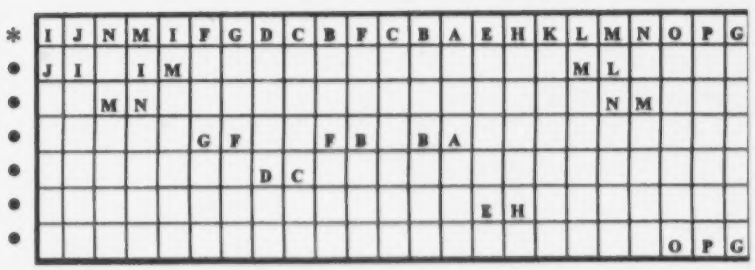
The square that is already filled in is a hint to get you started; it must be black in the completed puzzle.





Solution to Knossos Games in our September/October issue:





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VOLUME 5 • NUMBER 3

Opportunities and Resources for Academically Talented Youth

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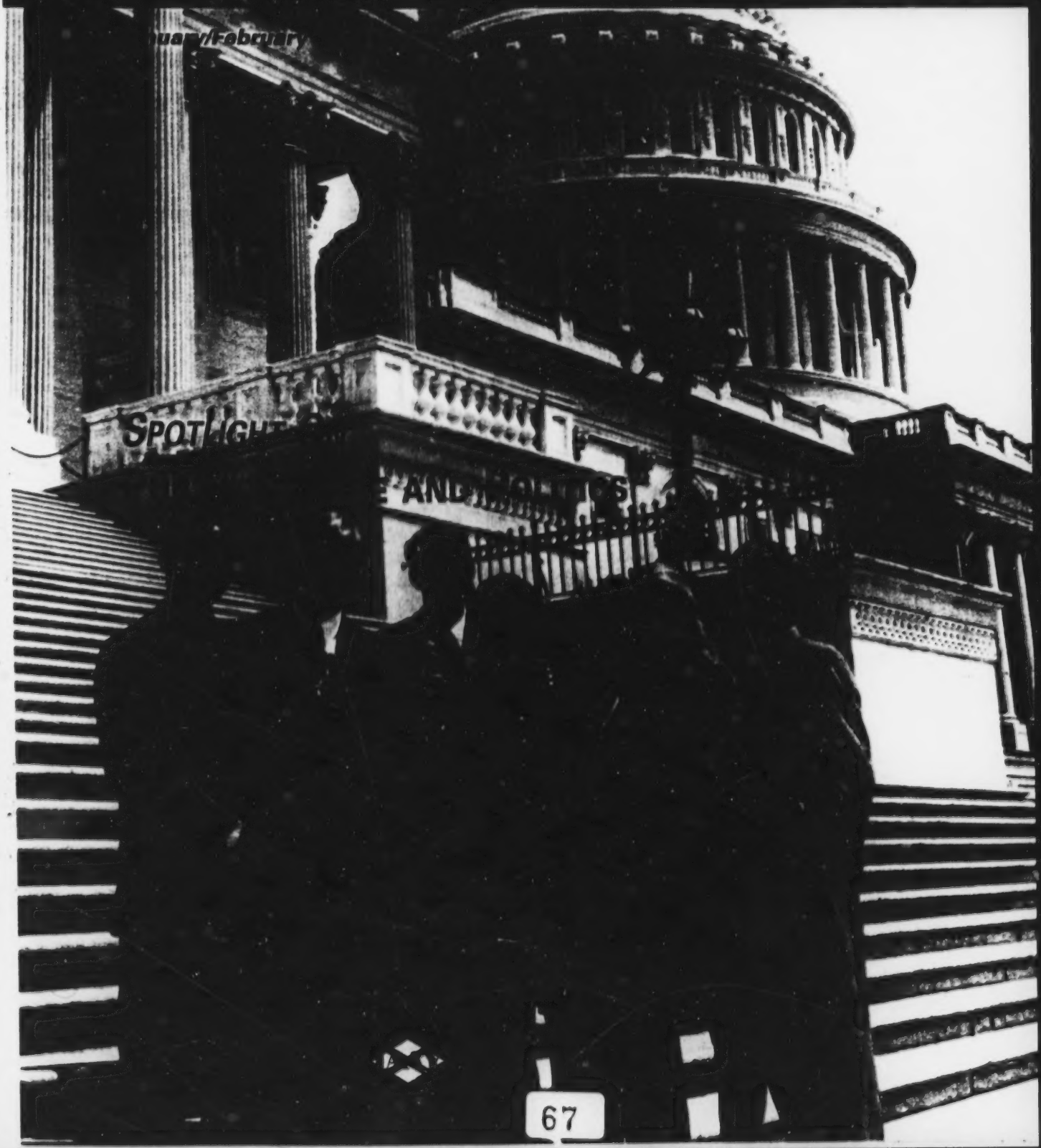

FROM THE EDITOR

Dear Reader,

If you've ever been a member of a club or a team, you know that membership includes not only privileges but also responsibilities. You might have to attend meetings or practices, for example, or participate in fundraisers to help finance a group trip. At the very least, you must invest some of your time, energy, and talent.

The same is true for you as a member of a community. Like a chess club or soccer team, your community requires the active involvement of its members to thrive. You can serve your community, just as you can choose your extracurricular activities, based on your interests. Perhaps you would like to help a specific group of people or to address a particular challenge; you might decide to participate in charitable activities that benefit the needy or the elderly, or environmental activities such as cleaning up a local park. The benefits of your work, both for you as an individual and for others, will more than repay your time and dedication.

You can also take part in the processes that shape your community by playing an active role in local, state, or federal government. Many students think that their role in government is limited to student government, but even if you're not old enough to vote, you can help influence the political forces that affect your life. You can organize a letter-writing campaign to your elected officials to urge them to devote more funds to gifted education, public libraries, or youth programs; you can attend city council meetings. You can even help put a candidate in office who is committed to issues you believe in by volunteering on his or her campaign.

As you read this issue of *Imagine*, you'll see a few of the many ways you can make a difference in the world around you through public service and politics. Two of our student writers describe the fundraising efforts they organized to address a need in their communities, while another explains how a leadership program led to her involvement in local politics. You'll hear from two young adults whose current interests in politics began with early experiences volunteering on campaigns, and from a high school senior who organizes political events and publishes a political newsletter at his school. And to show you what it's like to work in government as a high schooler, another student reflects on her work as a page. As our writers' range of experience demonstrates, you can get involved in many ways, at any age.

We round out the issue with our regular features and our annual listing of academic summer programs. By exploring both academic and volunteer opportunities, you'll create an education that prepares you to meet the challenges of college, career, and community.

Melissa Hartman

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Imagine...
*Opportunities and Resources for Academically Talented Youth**

ISSN 1071-605X
Volume 5 • Number 3
January/February 1998

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Published five times a year—September/October, November/December, January/February, March/April, and May/June.

Application to mail at Periodicals Postage Rates is approved at Baltimore, MD, and additional mailing offices.

POSTMASTER: Send address changes to *Imagine*, The Johns Hopkins University Press, Journals Publishing Division, P.O. Box 19966, Baltimore, MD 21211.

Imagine is published by the Johns Hopkins University Press for the Study of Exceptional Talent (SET) at the Johns Hopkins Institute for the Academic Advancement of Youth (IAAY). This publication is an outgrowth of newsletters and programs that, for twenty-five years, have served highly talented students identified by the Study of Mathematically Precocious Youth (SMPY) and by SET.

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Annual subscription: $30.00

Address subscription inquiries to:
Journals Publishing Division
The Johns Hopkins University Press
2715 North Charles Street
Baltimore, Maryland 21218-4363
(410) 516-6989 • fax: (410) 516-6968
toll-free: (800) 548-1784

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Cover photo courtesy of Junior Statesmen Foundation

CONTENTS

Focus On: Public Service and Politics

A Life of Politics, A Life of Service
A career in public service can be both tough and inspiring. Erica Gum explains why she has dedicated herself to this challenging field 4

Creating Candidates: Reflections of a Campaign Volunteer
Simeon Brodsky relates the experiences and realizations that have fueled his lifelong interest in politics 6

Exploring Government at the National Young Leaders Conference
A week in Washington, D.C. prepared Cynthia Soderblom to put her new knowledge and leadership skills into practice—in her local government 7

A Passion for Politics

Why should students care about politics? Dror Yuravlivker describes what he's doing to make politics relevant to his peers 8

Two Months at the State House: My Experience as a Page
As a page in the Iowa House of Representatives, Becky Ray learned about the workings of her state's government 10

Becoming a Consummate Debater
Interview with Rebecca Justice, a member of Johns Hopkins' 1997 debate team and one of the National Forensic League's top-ranked debaters 12

Winning Arguments, Round by Round
Three years ago, Robert Warren decided to observe a practice session of his school's debate team. Now captain of the varsity team, he gets to experience the excitement he saw that day 14

Imagine: Stop the Pain, Start the Music
Danielle Kalish reflects on the benefit concert that she organized in support of a local children's charity 15

Project Rescue Vision
Inspired by a story they'd seen on Dateline, *Cory and Brock Snyder decided to help their local fire department save lives* 16

Exploring Career Options: Robotics
Interview with Greg Chirikjian, Associate Professor of Mechanical Engineering at The Johns Hopkins University 18

Planning Ahead for College
Residential summer programs provide a great opportunity to immerse yourself in a fascinating topic—and to learn what it's like to live on a college campus 20

Selected 1998 Academic Summer Programs
Our annual listing of some of the best places to challenge yourself this summer 21

Fascinating Classics

John Steinbeck's Pulitzer Prize-winning The Grapes of Wrath 24

Students Review University of Virginia 26

The Coach's Corner 29

Creative Minds Imagine
The Strangest Planet I Ever Heard Of
by Stacy Cowley 30

Mark Your Calendar 31

Knossos Games 32

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NO MATTER HOW YOU see yourself—as a future biochemist, a Web master, a polyglot, or an ecologist—you are also a citizen. If you are an American, you are a member of a complex participatory democracy, with all the privileges and obligations that this implies. How will you meet the challenges of citizenship, both now and in the future?

The following articles were written by two young adults who have pondered the questions of citizenship since childhood, and who have found a variety of ways to participate in and contribute to American political life.

Erica Gum and Simeon Brodsky grew up in politically active families and became activists in their own right by middle school. Both chose volunteer campaign work as a way to support candidates they believed in while also educating themselves about political realities and gaining contacts and experience.

Erica and Simeon both studied politics as undergraduates and graduate students, but selected different career paths: As Erica explains, she has chosen to develop a career on or around Capitol Hill; Simeon, however, is a professional educator who pursues his political interests off the clock.

These writers present different possibilities for engaging in politics. They also offer exciting glimpses of the political world, thoughtful reflections on the workings of that world, and compelling reasons for each of us to listen to the call to public service.

A LIFE OF POLITICS, A LIFE OF SERVICE

by Erica Gum

After eight years in politics and public service, I've seen the good, the bad, and the ugly. I've also decided that I am enough of an optimist to dedicate myself to this demanding field.

Early Experiences: Campaigns . . .

The seeds of careers in politics and public service are often sown early. I remember accompanying my mother as she knocked on doors and gave away campaign literature before the presidential election of 1972. I was three years old. I started volunteering for political campaigns on my own in junior high and high school. Passing out fliers at parades and setting up for events was fun and, well, politic, helping me to get more responsible positions in other campaigns. I advanced from running errands to driving the candidate from place to place (and getting him/her there on time!), and from doing research to briefing candidates for meetings, drafting speeches, and writing campaign literature.

While campaign work is almost always unpaid, the rewards of participation are significant: a tremendous learning experience, the opportunity to serve the democratic process, and something valuable to add to your college or grad school applications or your résumé. Furthermore, if you do good work for a candidate running for a relatively high office, and if your candidate wins (a big if), you may be offered a job. After working on a mayoral campaign while completing graduate school, I was delighted when my candidate won the position of Mayor of Raleigh, North Carolina, by a margin of 900 votes and then offered me a few months' work as a policy analyst, researching ways to make the Raleigh city government more efficient. However, even if your candidate loses, jumping onto a campaign is the best way to find out whether you like the nitty-gritty of the political process.

. . . and Internships

In addition to working on campaigns, you may decide to apply for a more structured opportunity, such as a local, state, or federal government internship. Some high schools and most colleges and universities have established internship programs. Also, some states have competitive internship programs run through the Governor's Office. Most internships pay very little or are offered for college credit. But if you work hard and keep your eyes and ears open, they can be great learning experiences as well as stepping stones to greater opportunities.

In 1989, I was selected for the Maryland Governor's Internship Program. After my sophomore year at Johns Hopkins, I spent a summer in Annapolis at the Department of Budget and Fiscal Planning. One of my assignments was to translate part of the tax code into plain English. Through completing this task, I learned how politics affects economics—how, for example, some business interests, such as Maryland's crab and fishing industry, are awarded special tax breaks. These industries can exercise a great deal of political clout and can influence both state spending and state taxation.

The Rewards of Early Service: A Fellowship and a Scholarship . . .

Volunteering and interning helped me to gain extraordinary opportunities. As an

75

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undergraduate at Hopkins, I majored in political science and decided that I wanted to continue my studies at the graduate level. My sophomore year, I applied for and won a Harry S. Truman Scholarship, a highly competitive award available to undergraduates dedicated to careers in public service. The Truman helped pay for the last two years of my undergraduate studies and for two years of graduate school.

I pursued my master's degree in public policy at Duke in part because I had also won a Jacob K. Javits Fellowship, a graduate fellowship offered only at Duke University, Columbia University, and the University of California at Berkeley, which funded the tuition for my master's degree as well as a subsequent year of employment with the United States Senate. Winning both the Javits and the Truman made me feel tremendously honored and further strengthened my commitment to the life I had chosen.

. . . and the Launching of a Career

A great highlight in my life so far came in 1994, during the second part of the Javits fellowship. After a series of interviews, I became a legislative assistant to U.S. Senator Pete Domenici of New Mexico and made the coveted move to life as a professional on Capitol Hill. In Senator Domenici's office, working on telecommunications, transportation, and commerce issues, I met with constituents and lobbyists, wrote letters and speeches, and advised the senator on upcoming legislation.

At the same time, I witnessed the senator's efforts to ensure that insurance companies could no longer discriminate against people with severe mental illnesses. Domenici's hard work on this then-unpopular issue demonstrated to me that people with integrity can succeed in politics. Later, I felt great satisfaction working on his 1996 re-election campaign.

Constant change, which makes politics interesting, also means that the field has little job security. I experienced this firsthand in the middle of the 1996 campaign, when, after I completed my assigned tasks for Senator Domenici's campaign, my contract expired. I needed to switch quickly to another candidate's team. Through working for moderate Republican organizations, I was fortunate to find Mike Mahaffey, a congressional candidate from Iowa whose commitment to balancing the federal budget and reforming Social Security and Medicare reflected views similar to my own. Mahaffey took the principled stand that he would not run negative ads, a position that may have cost him the election. When he lost, I was disheartened, not only for Iowa and the country, but also for myself: out of a job, I remained unemployed for four months.

Since then I have rebounded, obtaining a position as a research associate with the Welfare to Work Partnership. The Partnership coordinates a nonpartisan, nationwide effort to encourage companies to hire people on public assistance and to provide them with support and resources when they do so. My job is to research welfare reform efforts in several states, while connecting businesses with community resources such as job training programs and day-care programs.

I believe that my efforts make a difference, helping to bridge the gap between the working world and those who currently rely on public assistance. And even though I am not working on Capitol Hill, I sometimes still feel the excitement of being at the center of the political world. For example, President Clinton recently visited a job training facility in Wichita, Kansas, that is run by the Cessna Aircraft Corporation, a business partner in the Welfare to Work Partnership. I helped coordinate the event and conducted research for a speech given by my boss. So, I helped write a message that was actually heard by the President of the United States!

Despite these positive experiences in my chosen field, I sometimes feel quite disillusioned and cynical. Politics should always be guided by the ideal of public service. But unfortunately, many politicians and other players in the political arena corrupt political discourse by running negative and misleading ads which confuse voters, discourage voting, and generate cynicism. Furthermore, elected and unelected officials sometimes work together to make bad laws. One of my most distasteful experiences came when I watched a well-organized lobby use its influence to push an unconstitutional law—the Communications Decency Act—through the Congress. (The U.S. Supreme Court eventually struck down this piece of legislation.)

Yet while disappointments are part of daily life in politics and government, this area of public service fascinates me and gives me a sense of purpose. In the right job, I support someone or something I believe in, and my actions help make other people's lives better. For example, assisting Senator Domenici, I helped make sure that laws governing the spending of federal transportation funds would not unfairly take away monies needed for roads in Navajo communities. Months later, I still feel proud of this single accomplishment.

Reflections from the Field

Even when one achieves distinction in government and politics, salaries can remain low and a nagging feeling that good work may not have lasting effects can remain. However, I confront my own occasional doubts with the words of President Harry Truman: "If you can't stand the heat, get out of the kitchen."

I agree with President Truman that people who are uncomfortable with politics should not commit themselves to political work. However, I also know that just as the kitchen is not the only room in a house, politics and government are not the only areas of public service. Anyone inspired by the ideal of public service should at least consider teaching, scientific research, social work, or the many other areas in which dedicated individuals can truly make a difference. I am convinced that many fields offer the satisfaction that I have found in politics: the feeling of accomplishment that comes with working for something you believe in, the wonderful sense that you have served the public good.

Creating Candidates: Reflections of a Campaign Volunteer

by Simeon Brodsky

At seven years old, attending a political rally with my parents, I met Henry "Scoop" Jackson, a 1972 candidate for the Democratic presidential nomination. A newspaper picture capturing our encounter is still tucked away in one of my mother's scrapbooks. Amidst the fanfare, I felt a strong impulse to reach out to Jackson in a private way, and so gave him an owl-shaped eraser for his kids, who I knew were my age. Now, I look back on my gesture as a first attempt to create personal meaning in the public arena of politics.

At ten, I joined Jimmy Carter's "peanut brigade," inspired by his commitment to all Americans, including those with fewer privileges. I enthusiastically rang doorbells, handed out flyers, and hung out with the women in the phone bank in campaign headquarters in Chattanooga, Tennessee, while adult volunteers I knew made the long bus trip to Iowa so that they could help Carter win the first primary. Although I was very young, I knew that, for me, Carter's grassroots campaign embodied the idea of democracy.

Creating a Presidential Image

In 1983, at 18, as one of presidential candidate Gary Hart's "hart-beats," I handed out flyers, made phone calls, and recruited volunteers. One memorable day, I even got to drive in an official motorcade and meet Hart as he prepared to board a plane for his next stop. In the moment of our meeting, inches from his face, I felt that Hart, the dynamic, impassioned speaker I had just watched mesmerize a crowd, now seemed peculiarly vacant up close, a hollow shell operating on autopilot. Seeing Hart look startlingly empty made me realize the degree to which his campaign was a performance. I gave up my innocent appreciation of American politics, realizing that campaigns not only promote candidates, but also create them.

The campaign had re-created Hart in an image that was designed to be viewed from a distance. This re-creation, I understood, required the participation not only of Hart's advisors, but also of all his supporters, the media, and, to an extent, the American people.

For a former soldier in the peanut brigade, the discovery that candidates are partly manufactured was somewhat disillusioning. But ultimately I was more intrigued than disappointed. After all, if candidates are the products of many influences, working on a campaign offers an opportunity to be a lot more than a cheerleader. My new sense of the radically collaborative nature of campaigns made me even more fascinated with politics and even more confident that I could have an impact in the political arena. I decided to major in political science as an undergraduate and to seek my Ph.D. in American Politics.

While I was in graduate school, the urge to work on a campaign arose again. Remembering the lessons of the Hart campaign, I thought my contribution to the "production" of a candidate would be more significant and rewarding if I worked on a local campaign, where there is greater access to candidates and where the implications of a candidate's position on the community are clearer and easier to communicate. I chose an exciting city council candidate in Pittsburgh, Pennsylvania; he was young, educated, attractive, and had plenty of money to spend.

Struggling with Consultants

However, this campaign, while more grassroots than a national campaign, was not as homespun as I had expected. Unlike many local election efforts, this one was marked by big spending, and I found myself handing out slickly produced materials designed by professionals—materials that trumpeted the candidate that consultants had decided everybody wanted to see. The lead consultant even came from "inside the beltway" of Washington, D.C., which at the time was considered evidence of professionalism. The expert used his polling results to target key areas of demographic support and then employed negative campaign tactics, based largely on George Bush's successful strategy of attacking the record of Michael Dukakis rather than focusing on his own.

I soon suspected that this negative approach was a strategic error. Taking advantage of our easy access to the candidate, my fellow activists and I tried to convince him to change strategies. Soon a battle ensued between the consultant—highly paid and armed with polling numbers—and a bunch of volunteers who were spending hours each day trudging door-to-door in the summer sun. Ringing doorbells and talking to voters gave us a very different perspective than that of either the consultant or the candidate. Our primary opponent was a longtime member of the community and a fast food executive. As I talked to voters, I was routinely chastised for our negative mailings and personal attacks. Everyone in the neighborhood had at least one family member who had gotten a job in his restaurants, or through his intervention. It seems fast food restaurants are always hiring.

We heard complaints. We heard stories. We were even yelled at. In short, we knew the strategy was wrong. Rather than producing an effective candidate, one sensitive to our opponent's stature and influence in the community, the consultant implemented a strategy out of context—the negative campaigning that he had exported from Washington.

My candidate finished a disappointing third in the primary. Although my experience was exasperating, I was heartened by the community's ability to detect the disjuncture between what they wanted and the candidate we produced. My candidate truly cared about the voters in a way that, unfortunately, never came across; if elected, he would have been good for the community.

Since that frustrating summer, I have bided my time, waiting for a political candidate I felt excited to support. I have worked a little on national campaigns, but know that another local candidate will catch my attention one day soon. Perhaps then I will try my hand again at creating a winning campaign.

Simeon Brodsky, a Program Coordinator at IAAY, is working toward his Ph.D. in political science at the University of Pittsburgh.

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Exploring Government at the National Young Leaders Conference

by Cynthia Soderblom

I've always perceived politics and government as somehow unconnected to most of the American population, including me. This perception changed last winter, when I visited Washington, D.C., to attend the National Young Leaders Conference. After spending a week in our nation's capital learning about the process of government, I realized that government is really the work of many people, including ordinary citizens.

Each day the conference focused on a different topic, such as "America and the World" or "The Executive Branch and the Media." In our Presidential Groups (about 20 students with a leader), we participated in simulations that enacted the day's theme. In the Presidential Crisis simulation, for example, I acted as the Senate Foreign Relations Committee Chairwoman. As the simulation progressed, I learned that the president must consider his advisors' comments when making decisions, and I gained a deeper appreciation of the powerful role these advisors play in determining policy.

We also learned about government from elected officials. On the day we explored "The Legislative and Judicial Branches of National Government," we spent about an hour on the floor of the House speaking with James Clyburn, who described the path that led him to Congress. Later, after we toured the Library of Congress and the Supreme Court, some students were able to meet their senators and representatives in the House and Senate office buildings. We also saw how much work goes on in the office buildings, where aides for every senator and representative were busily preparing and organizing materials. I had never realized how much public figures must rely on their behind-the-scenes workers.

The next day, which focused on "The Executive Branch and the Media," began with a breakfast at the National Press Club. We listened as four seasoned Washington reporters, including Helen Thomas, who has covered the executive office since the Nixon administration, discussed their profession. I could tell that the reporters knew the government and its leaders very well from following their activities and reporting them to the public. Later, when James Hall, Chairman of the National Transportation Safety Board, spoke to us about how the government must work with the press, I realized that political leaders must also be public relations people: They have to make a good impression on the press because the press will convey this image to the public. After this breakfast, I could see how and why the government and the press are so tightly intertwined.

We spent the rest of that day preparing for the central event of the conference—the Mock Congress. Each Presidential Group was part of leadership, a committee, or a caucus; each group was given a stand to support. My caucus stood for a "moratorium on immigration to absorb the recent increases in both legal and illegal immigration." We campaigned by deciding which caucuses to support in exchange for their backing. Since there were many more opposing caucuses than potentially supportive ones, we had to decide what to trade off—more votes for a small revision in our amendment, or fewer votes for our radical stand. We also appeared before the "House" and "Judicial" committees, who reviewed our amendments. I couldn't believe how much work is involved in the formation of a single amendment. Unfortunately, since our stand was so radical, only one other caucus agreed to vote for it, and our amendment failed.

Although we spent most of our time learning about government, there was time for socializing, too. During evening socials, students could gather to talk and eat ice cream. We toured the capital in buses and shopped together in D.C.'s malls, which provided opportunities for interesting conversations with people from all over the world. The conference also arranged for entertainment, such as a performance by "The Capitol Steps," a political satire theater group. And on the last night of the program, we celebrated at a Farewell Dinner Dance at the Omni Shoreham Hotel.

Probably one of the most important things I learned at the National Young Leaders Conference is how much power an ordinary person has to make a difference. Even though I am not old enough to vote, I have found ways to make my voice heard in government since attending the conference. I joined the Marin County Youth Commission, a group dedicated to representing youth and youth issues to the county government. We recently completed the Youth Files, a summary of local city council candidates' positions on youth issues. Each of us interviewed different candidates, asking about their views on such topics as curfews and youth-adult relations. We then made presentations at our schools and other teen gathering places.

Through the Youth Commission, I have been able to present issues to people I normally would not have approached—a county supervisor, for example. I have also been able to make my peers aware of issues they might not have known or cared about; I have encouraged students who are old enough to vote to do so. All of this is a direct result of the Young Leaders Conference, which not only made me interested in finding a forum for my views and those of my peers, but also gave me the leadership skills to do it.

Cynthia Soderblom is a senior at San Rafael High School, where she runs on the varsity track and cross country teams and participates in student government. She plans to major and pursue a career in biology.

The Congressional Youth Leadership Council sponsors sixteen sessions of the National Young Leaders Conference during the school year and four sessions during the summer. High school juniors and seniors may either be nominated for selection by teachers, administrators, or NYLC alumni, or apply directly to the NYLC for an achievement nomination. For more information, contact the Congressional Youth Leadership Council, 1511 K Street, N.W., Suite 842, Washington, D.C. 20005; (202) 638-0009.

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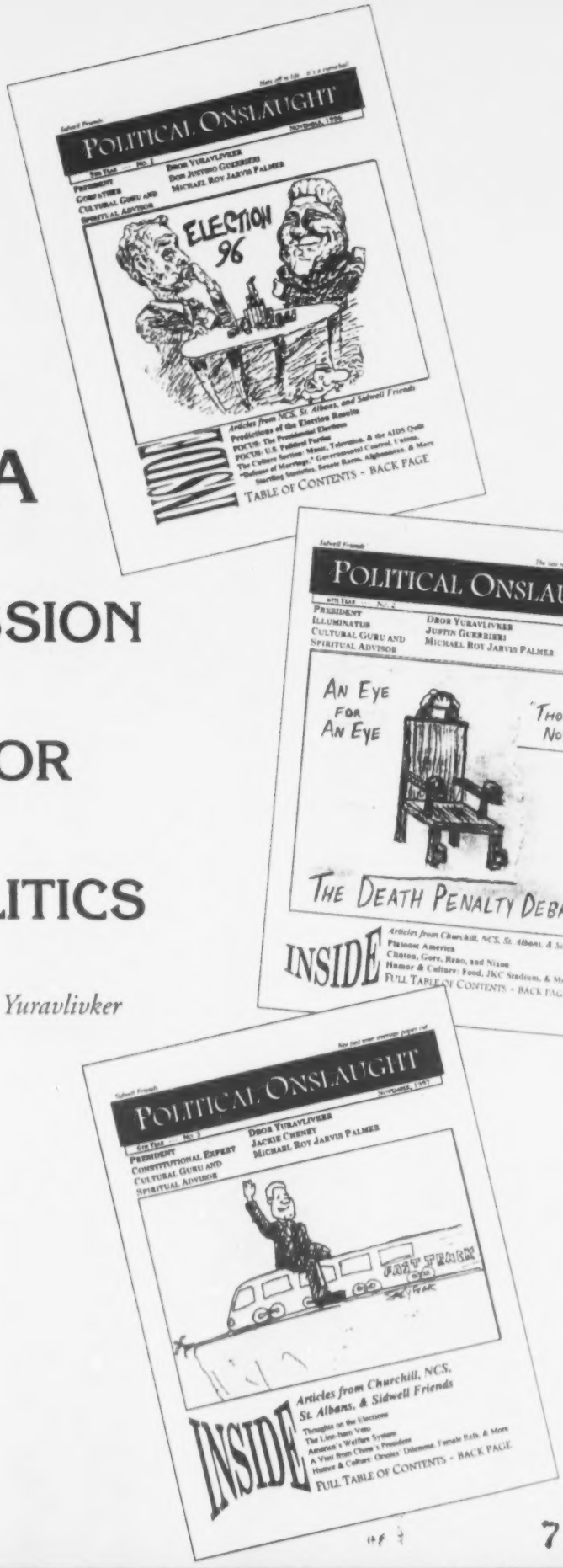
A Passion for Politics

by Dror Yuravlivker



Do you remember the Persian Gulf War? I do. I was in fifth grade at the time, and I remember coming to school on the war's first day, full of patriotism and "Go Bush!" enthusiasm. That night I watched the PBS show *Frontline*, which happened to feature an exposé on the Iran-Contra affair. The very next day, I walked into class and said that George Bush should be impeached. From then on, I took an active interest in politics and world affairs. I was hooked.

From Interest to Involvement

By the time I reached middle school, my interest in politics was growing rapidly. I worked for my school newspaper, often writing about politics (the 1992 elections, for example) and world events. My social life, I admit, was less than remarkable. But perhaps for that very reason politics excited me so much: I could enjoy it, take part in it, aspire to it, no matter how popular I was. At the end of middle school, my classmates voted me "Most Likely to Be President."

After middle school, I came to Sidwell Friends, a school in Washington, D.C. Here, many students shared my enthusiasm for politics. Immediately, a few new friends and I formed a Young Democrats club. Since the 1994 elections were coming up, we called several campaigns for literature, buttons, and stickers, and we organized a trip to a Maryland gubernatorial debate. The last major event the club sponsored was a school-wide assembly featuring Massachusetts Congressman Barney Frank. Mr. Frank was well received, and his speech about America's role in the world went over extremely well with the students.

Putting Politics in Print

Soon after I began attending Sidwell, the founder and editor-in-chief of the school's political magazine, *Political Onslaught*, asked me to write an op-ed piece. A month later, explaining that he was a senior and ready to turn the publication over to someone else, he offered me the editorship. And a few months after that, I put out my first issue—three articles.

Since then, *Political Onslaught* has not only survived—it has thrived. Once just a

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few pages of satire, the most recent issue filled 22 pages with student drawings and writing, both serious and satirical. Contributors come not only from Sidwell, but also from three other area high schools. Issues we've covered during my editorship have included American, Israeli, British, French, and Canadian elections; relations between the U.S. and Cuba; affirmative action; Middle East politics; campaign finance reforms; free trade; films and culture; and, most recently, the death penalty. We've also added a section called "Humor & Culture," for which several of my funnier classmates write hilarious articles that often have nothing to do with politics.

Sidwell Friends is an overwhelmingly liberal school. The Sidwell writing reflects this progressive bent, and this is one of the reasons I chose to expand to other high schools—to increase the amount of conservative writing. I feel that the only way to make informed choices is by hearing many sides of an issue. Now, though Sidwell's liberal leaning still comes through, the content of *Political Onslaught* is much more balanced.

Dror speaks with Mickey Kantor after a lecture on Political Day 1996

The staff consists of two people, including me. We publish an issue of *Political Onslaught* roughly every month. My work includes persuading people to write articles, laying out the magazine, and everything in between. When we have a deadline, I'm often up past midnight three nights a week to get everything done. But it's worth it.

Bringing Government to School

In addition to publishing *Political Onslaught*, I have tried to generate political awareness among the student body through Political Day. Based on earlier events at Sidwell at which speakers delivered seminars, Political Day involved students for a full day in a variety of activities.

I led the team of students and faculty who put Political Day together. I wrote letters to and called the 30 speakers to secure their appearances, delegated the jobs of hosting the speakers to 30 classmates, and motivated students to decorate the school and theater with political banners and posters. Most importantly, I coordinated all of these efforts to ensure that the day ran as smoothly as possible.

Political Day took place a few weeks before the 1996 elections. At a morning assembly, Bill Kristol, Editor of *The Weekly Standard*, and Ann Lewis, Deputy Campaign Manager and Director of Communications for the Clinton-Gore re-election effort, debated on stage before the entire school. CNN anchor Judy Woodruff moderated the debate, which students found exciting and informative.

After the debate, students headed to seminars. Twenty-five men and women active in the Washington political arena spoke to groups of 15–20 students on topics ranging from abortion to the economy to national health care reform to relations between politicians and journalists. Most memorable for me was a lecture delivered by Mickey Kantor about the changing role of government in today's global economy. Then Secretary of Commerce, Mr. Kantor made a strong pitch for free trade.

After lunch, the entire school heard a pollster from Hart Research compare results from an NBC/*Wall Street Journal* poll and a similar poll of the Sidwell student body. Finally, our keynote speaker, Kathy Whitmire, the former mayor of Houston and President of the National Council of Mayors and currently the only woman on the board of the New York Stock Exchange, spoke about how we could get involved in politics.

Political Day was a complete success in intensifying the students' interest in politics and the elections. Political Day earned a two-page spread in the yearbook, which noted the organizers and the distinguished guests who came to speak. But even more memorable than the day itself was the work behind it—the time and energy, the teamwork, and the pure will all of us invested to make Political Day such an achievement.

Politics: For Our Future

It saddens me that so many people remain ignorant of politics and government. The American political experiment of democracy can succeed only if people take an active role, if citizens keep themselves informed of the world around them, and if everybody is willing to work for what they believe in.

I want to make a difference in this world—that is why I am so passionate about politics. I try to engender that same passion in those around me by every means possible, such as *Political Onslaught* and Political Day. I try to make politics relevant to my classmates because we are the next generation: in ten, twenty, thirty years, we will be the political leaders, the teachers, the parents. If today's youth feel empowered and optimistic about the future, tomorrow's world will reflect that.

Dror Yuravlivker never sleeps: aside from engaging in political activities, he plays piano, acts in school plays, and plays and referees soccer. He has also worked at the Center for Political Leadership and Participation (U-MD) and volunteered at the Holocaust Museum. He hopes someday to be a teacher and/or a member of Congress.

Contact Dror at dyurav@sidwell.edu to receive a copy of Political Onslaught (or to subscribe). You can also see some issues on the Web at www.sidwell.edu/sidwell.resources/clubs/onslaught

Two Months at the State House: My Experience as a Page

by Becky Ray

Imagine reading the results of a vote before anyone else. Imagine working on a daily basis with your state's elected officials. Imagine leaving high school for two to four months to work full-time, while keeping up with your regular class work. My junior year in high school, as a page in the Iowa House of Representatives, I experienced all this and more.

The process of becoming a page is highly competitive—of the approximately 200 students who apply to the Iowa House of Representatives each year, about 40 will become pages. Weeks after sending in my application, I learned that I qualified for an interview at the capitol. I met with two representatives, one Republican and one Democrat, who asked me about my experience and why I wanted to be a page. One day the Chief Clerk of the House called me at school and told me that I had been selected.

About two weeks before the session began, all the pages attended an orientation and learned the basic rules of protocol for dealing with politicians and lobbyists. Mostly the guidelines were based on common sense: we shouldn't step between two debating representatives, for example. The Sergeants-At-Arms explained lunch hour, breaks, paychecks, and the other ordinary aspects of work. We also received our uniforms—slacks or a skirt and the official navy blue blazer. That blazer, along with my page nametag, meant I could go anywhere in the capitol complex on official errands. It was fun to visit the different offices inside the State House and the offices elsewhere on the grounds, which required a walk through a maze of underground tunnels.

At orientation, I also learned that I had qualified for a special post in the *House Journal* office. The *House Journal* is a daily newsletter that lists current items of business and voting records. The *Journal* is distributed throughout the capitol complex and to area businesses and lobbyists with relevant interests. My duties began with proofreading amendments aloud and making copies. As the session progressed, I began performing other tasks, such as downloading amendments and other documents from the capitol mainframe, typing the text of the *Journal*, and delivering bundles of the *Journal* throughout the capitol complex.

At times I felt as if I was only a gofer, but I realized that by helping the politicians to complete their work more efficiently, I was playing a very important role.

A Day in the Life

Work began in early January and lasted two months. Because I liked to get a head start on my duties in the *Journal* office, I would usually arrive at 7:30 a.m. Around 8:00 a.m., I began to download bills and amendments and proof them. The text of the bill would be published in that day's issue of the *Journal*.

At 9:00 a.m., the House convened. After the Pledge of Allegiance, an invocation by a religious leader, and an announcement of the day's schedule of meetings, it was time for debate. Since I was in the *Journal* office in the morning, my job was to listen to debate on the loudspeaker and type items for the next day's edition. I also double-checked the results of votes, which usually led me right up to my lunch break.

The second half of the day was, for me at least, much different from the first half. Instead of working in an office, I was now in the center of the action. The House floor has 100 seats, two press benches, two page benches, the phone room, the bill room, and the "well" where the Chief Clerk and Speaker sit. Behind the well are offices and the rooms where the two parties caucus. "Working the floor" involves traveling among all of these places, sometimes within an hour.

Pages sit on the benches in the back of the room until they are called. When representatives or clerks need a page, they press a button on their desk, which is connected to a board in the back of the room by the page benches. The board lights up a number corresponding to the number of the desk, and a bell rings. Then one of the pages (we usually took turns, but we all had our favorite representatives) goes to the desk to receive his or her assignment. For example, reps asked us to get copies of legislation, deliver messages to a colleague in the Senate, get them a snack, or talk to a lobbyist they didn't have time to see.

During debate, we had to move particularly fast so that the reps didn't have to stop debating to wait for us to bring the text they needed. Debate was exciting and stressful, especially when we couldn't get to the desk because of the rules about not walking between two debating representatives. But when debate was over, and work slower, sometimes the representatives would talk to us for a few minutes about college plans, our political leanings, or even popular music. So working the floor is really quite a

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diverse activity, and one that made our afternoons quite exciting.

Once every couple weeks, the Sergeants-At-Arms would assign us to work in the phone room. Two people run the House switchboard, and they employ two pages each day to wait for phone messages. When they accumulate five or so messages, the pages take them to the representatives. It was good to learn that representatives really get phone messages from their constituents. I know that if I ever call about a bill that's important to me, the representative will get a written message about my call. And even better, if the representative is at his or her desk at the time, I can talk on the phone with him or her about my concerns. Witnessing the interactions of representatives and ordinary constituents improved my faith in state government quite a bit.

The late afternoon was a time for committee and subcommittee meetings. From 2:30 on, I might find myself sitting in a committee meeting, listening to discussions about finance, ethics, ways and means, transportation, or other topics. I always had to be ready to run to get bills, books from the law library, or food for the representatives. At times I felt as if I was only a gofer, but I realized that by helping the politicians to complete their work more efficiently, I was playing a very important role.

Becky and Iowa Governor Terry Branstad

At 4:30, we would be dismissed from work, unless debate was particularly long that day, in which case we would stay anywhere from a half-hour to five hours longer. I drove home to my aunt's house in a suburb of Des Moines, which is where I lived for those two months. Most nights I spent doing my homework, but on Wednesday nights, all the pages got together. Not everyone lived with family; some pages rented apartments or college dorm rooms.

Becky (second row, third from left) with all of the pages and the Sergeants-At-Arms in front of the well on the House floor

We sometimes went to those places to watch movies, or to the mall or restaurants around Des Moines. Getting to know each other made a big difference in our teamwork, I think.

Work at the State House allowed me to meet some very interesting people. Different associations from around the state would come to talk to the House or Senate, so I got to speak with people from the American Cancer Society, Iowa Association of Counties, Big Brothers/Big Sisters, and other groups. The capitol also attracted some famous people: I met Phil Gramm, Troy Davis (Heisman runner-up from Iowa State University who visited the House to give a speech), and I even heard that George Stephanopoulos stopped by.

Balancing Roles

How did I juggle schoolwork, a full-time job, a social life, and extracurriculars, all while living 60 miles from home? Well, I had to give up certain things. Speech and drama went, as did some pep band appearances. I neglected some things, like Mock Trial and Quiz Bowl. But there was time to do homework at night and during the day when work was slow. I also got help from my teachers, who faxed tests, assignments, and study sheets to me at the State House.

Although it is difficult to keep up with the demands of being a page, most students thrive on the challenge, and the benefits make all the hard work worthwhile. For example, I learned office skills, such as working with computer software, proofreading, and filing, and new interpersonal skills from dealing with a wide range of people. And I can get letters of recommendation from representatives if I ever need them for a scholarship or job application. I even got some leads on potential jobs if I decide to work as a clerk between college and law school.

Since the House session lasts for about four or five months, pages have the opportunity to stay for the whole session instead of just for two months. Pages with special assignments, like mine in the *Journal* office, can truly benefit from staying on. But with my courseload and extracurricular activities, I decided that it would be too much for me. Still, I'm grateful for the time I spent at the state capitol. It was a tremendous two months, and I carry with me experiences and relationships that I will always remember, and skills I will use all my life.

Becky Ray is a freshman at Kenyon College in Gambier, Ohio, where she enjoys being a founding member of Vertical Hootenanny. She grew up in Iowa and loves corn, music, foreign languages, and Quiz Bowl.

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Becoming a Consummate Debater

Interview with Rebecca Justice

by Eileen Ptak

As a senior in high school, Rebecca Justice was ranked one of the top ten high school debaters since the 1920s by the National Forensic League. She recently won the 1997 American Parliamentary Debate National Tournament as a senior at The Johns Hopkins University.

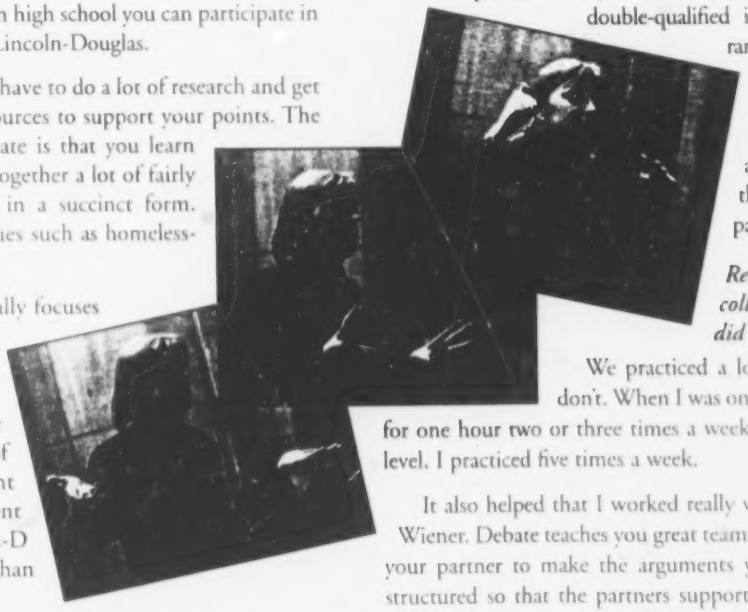
How did you become interested in debate?

My family has always been involved in debate. In fact, my grandfather started my high school debate team. My father, all my aunts and uncles, and my grandmother were excellent debaters.

That's quite a precedent to follow. What kind of debate did you compete in as a high school student?

I competed in policy debate. In high school you can participate in two kinds of debate: policy and Lincoln-Douglas.

Policy is evidence-based. You have to do a lot of research and get information from a variety of sources to support your points. The educational value of policy debate is that you learn how to research very well, pull together a lot of fairly heavy material, and present it in a succinct form. Policy focuses on real-world issues such as homelessness and the environment.



Lincoln-Douglas debate usually focuses on philosophical questions, such as the letter of the law versus the spirit of the law. Arguments in L-D debate are based on moral values instead of evidence. L-D debaters might argue about capital punishment or physician-assisted suicide. L-D debate stresses rhetoric more than policy debate does.

What type of debate did you participate in at Hopkins?

I competed in parliamentary debate. Usually a college-level activity, parliamentary debate combines elements of both policy and Lincoln-Douglas. You use a lot of philosophy because parliamentary debate doesn't use evidence. But you also tend to debate real-world issues. The topics are usually taken from the newspaper or major magazines such as *Time*, *U.S. News & World Report*, *The Economist*, and *Christian Science Monitor*.

Parliamentary debate is modeled on the style used in the British House of Commons. A two-member Government team presents a case, and a two-member Opposition team attacks it. Parliamentary debate incorporates conventions specific to the British parliament: members of the audience rap on tables to applaud, and there is no formal cross-examination period. Instead, debaters may interrupt by standing up and saying, "point of information." The speaker has the option to either take the question or decline. It is bad form to decline questions, so everyone has to learn how to work with the interruptions.

It is quite impressive that you rank among the top ten of all time in the National Forensic League. How did you earn that rank?

Well, my ranking may be a little lower than that now—it changes every year. The National Forensic League (NFL), the largest high school speech and debate organization in the country, assigns point values for winning tournaments and for qualifying for national competitions. At the end of a student's high school career, the NFL tabulates the points debaters earned and ranks the students.

I qualified for Nationals three years in a row, in my sophomore, junior, and senior years. Most people qualify only once, so I earned a lot of points that way. Also, in my last two years of high school, I double-qualified in both Foreign Extemporaneous Speaking and debate, thus doubling my points. And because I competed in several different events, I accumulated more points than students who participated in only one.

Reaching the Nationals in college is also impressive. How did you accomplish that?

We practiced a lot, and many college teams don't. When I was on the varsity team, I practiced for one hour two or three times a week. When I was at the novice level, I practiced five times a week.

It also helped that I worked really well with my partner, David Wiener. Debate teaches you great teamwork skills. You have to trust your partner to make the arguments you need—the speeches are structured so that the partners support each other. Teams without this kind of close working relationship do not win.

To compete in the Nationals, you have to win at least one tournament during the year. David and I won several tournaments, qualifying for the American Parliamentary Nationals along with 75 other teams. In the final round, we faced off against the team from Princeton. We flipped a coin before the round began to determine which team would be Government and which would be Opposition. Because Princeton won the coin toss, they chose to be the Government team—a distinct advantage because Government chooses the debate topic, and they have ten minutes to prepare. David and I didn't know the topic until they began to argue their case.

They chose to defend affirmative action, contending that it had been good for America in the past, was good in the present, and will continue to be good in the future.

We countered by arguing that affirmative action was the government's excuse mechanism: The government *could* have responded to the problems of inequality by enforcing government rulings such as

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Brown versus the Board of Education and the Civil Rights Act. Instead, the government chose an easier route with fewer political risks.

We argued that not only is affirmative action *not* beneficial to minorities, but it has also impaired their struggle for equality. Affirmative action has actually reinforced in the bigot's mind that minorities are not capable of advancing based solely on their merits. Because we won that round, we won the tournament.

Niall O'Murchadha raises a point against Rebecca in the 1997 National Tournament

What skills have you developed over the years in debate?

Debate forces you to think on your feet. Each time you debate, the other team spends the whole hour attacking the construction of your arguments. Although this is a humbling experience, it allows you to continuously improve the organization and logic of your thought processes.

You also develop the confidence to speak in front of large groups of both peers and adults. This kind of confidence, which is rare in a society where so many fear public speaking, gives you composure in many different situations.

Debate also expands your vocabulary. The more you speak and read to prepare, practice, and compete, the more vocabulary you learn. The best way to remember new concepts and words is to use them, and debate forces you to do exactly that.

It sounds as though these skills would be useful to many people, not just aspiring lawyers and politicians.

Absolutely. A number of the debaters on the Hopkins team aren't interested in a legal career—many are pre-meds and engineers. The skills you develop—thinking quickly and logically, speaking confidently, and expressing your thoughts succinctly—are helpful for job interviews and in the workplace, whether it's in law, medicine, or academia.

What is the most memorable part of your debate experience?

Without a doubt, the people I have met. Whether or not you're a good public speaker or are interested in developing better skills, you will meet a lot of amazing people through debate. Even though I went to a very small rural high school in Indiana, I met people through debate from all over the state and nation who were among the nation's best and brightest. In college, the parliamentary debate circuit has produced a number of impressive individuals as well: A former national champion is now a professor at Columbia Law School; another national champion is Justice Rhenquist's clerk at the Supreme Court; both members of the University of Pennsylvania team that won the American Parliamentary Nationals in 1996 are first-year students at Harvard Law School; and my partner, David, is a Fulbright scholar! It's no accident that these people are so accomplished. Debate brings interesting, sharp people together—it's a great way to broaden your horizons.

The Three Faces of Debate

Modeled on the famous 1858 debate between Abraham Lincoln and Stephen Douglas on the issue of slavery, **Lincoln-Douglas** debates are one-on-one and usually focus on a moral issue, such as gender equality or capital punishment. Each year two debate topics are chosen by the National Forensic League, and students have several months to prepare their opening speeches. Debaters have a chance to cross-examine the opposition and rebut the arguments, but these speeches are reactive, not prepared. As a result, students need to anticipate arguments from the other team and must research both sides of the topic. Because it is more philosophical than other types of high school debate and does not require evidence, L-D debate focuses more on rhetoric. Scoring is based on speaking style, persuasiveness, organization, and responses to cross-examination.

Policy debate centers on one topic each year, chosen by the National Forensic League, related to a hypothetical national policy. For example, last year's resolution asked students to argue whether or not "the federal government should establish a program to substantially reduce juvenile crime in the United States." The affirmative teams must support the resolution, and the negative teams must argue against it. Debaters work in teams of two to gather supportive evidence, such as scientific data and previous or current political policies, and must construct briefs (similar to legal briefs). As in L-D debate, the opening speech is prepared, but cross-examination speeches are reactive. In addition to speaking ability, effectiveness, and organization, scoring is based on quality and quantity of evidence.

Patterned after the procedures used in the British Parliament, **parliamentary** debate combines policy and philosophy. Debaters argue about topics as diverse as whether humans are the only creatures who consume without producing and whether dress codes should be mandated in public schools. Two two-member teams—the Government team and the Opposition team—each deliver two statements and one rebuttal. Since parliamentary debate is extemporaneous, students must prepare for any possible topic. At a tournament, the Government has ten minutes before the round to prepare their arguments. The Opposition team learns of the debate topic only when the Government team begins their speech and must construct their arguments while they listen. Scoring for parliamentary debate is based on rhetoric, analysis, organization, and knowledge of the subject.

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Winning Arguments, Round by Round

by Robert Warren

I became interested in debate in my sophomore year of high school. I'd had some experience in public speaking, and I've always been interested in the social sciences, so when the debate coach at my school invited me to watch a practice round, I accepted his invitation.

I walked into the debate room expecting to hear carefully reasoned speeches articulated with practiced precision. Instead, I saw four speakers frantically taking notes, grabbing evidence out of folders, and giving speeches that conveyed volumes of information at an insanely fast pace. I managed to catch a word here and there, such as "nuclear war," one of the few concepts I understood. These people, I thought, weren't debaters; these people were fast-talking salesmen trying to sell a backyard bomb shelter. This was my introduction to the world of policy debate.

But novice debaters shouldn't be intimidated by this scenario. Many of the skills necessary in debate, such as speaking quickly and constructing effective counterarguments, can be developed in practice rounds and in the novice-level rounds offered at many tournaments.

Learning the Skills

Although my partner and I had received a lot of advice from our debate coach and other members of the team, neither of us was really prepared for our first tournament. The first couple of rounds were horribly muddled, and few of our arguments made sense. Of course, the other novice teams were in the same position. But after each round, the judge gave us advice on how to improve our strategy, and by the end of the tournament, we were making more coherent arguments.

We did not develop the ability to speak quickly until many tournaments later. Speed is important in policy debate because it allows you to establish more evidence within the limited time frame. But as we learned in our early tournaments, speed is not as important as the ability to deliver clear, coherent, concise, and convincing arguments. Debaters who understand, synthesize, and present their arguments clearly are the ones who win the round.

Background Research

Preparing for debate involves weeks of research—searching books, magazines, newspapers, debate handbooks, and even the Web for information. A new topic, or resolution, is determined each year by the National Forensic League. This year's resolution is that "the federal government should establish a policy to substantially increase the use of renewable energy in the United States."

To be successful in policy debate, you have to research both sides of an issue. At tournaments, a panel decides which team will affirm the resolution and which will refute it for each round, so you must be prepared to argue either side. And because all rounds will center on this one topic, you will eventually debate both sides. Finally, by preparing both sides, you can anticipate your opponents' main points and deliver a more effective argument.

As an Affirmative debater, that is, a debater who supports the resolution, I might argue that promoting renewable energy sources will slow global warming. In my "aff" folders I would place articles proving that global warming is dangerous and that renewable energy sources could reduce global warming by eliminating emissions from fossil fuels. But as a Negative debater, I would have to adopt a completely different set of arguments. In my "neg" folders I would file evidence that global warming is a scientific hoax or that warming helps plants grow by lengthening the growing season. I would take all of my folders to every round.

The Competition

After a few weeks of preparation comes the chance to compete with teams from across the state, or in some cases, the nation. A typical tournament spans two days with five rounds each. Once the season gets into full swing, several tournaments will be held around the state each weekend.

Rounds generally last a little over an hour, a short span when you consider everything that happens in a round. Each team presents its case in an eight-minute "constructive speech," after which the opposing team has three minutes to cross-examine. Each team then gives a second constructive speech with another opportunity for cross-examination. Then the rebuttals begin: in five-minute speeches, each team responds to the other's argument and summarizes its own position.

While the order of speeches and cross-exams is fixed, many variables influence their content. So even if you're on the same side for two consecutive rounds, there's no guarantee that what worked in the last round will work in the next. You'll rely on the same folders for evidence, but you must always be prepared to adapt your strategy.

The Rewards

Most tournaments end with an awards ceremony, at which the top teams and most persuasive speakers receive trophies, gavels, or certificates for their accomplishments. But the rewards of participating in debate extend far beyond the tournaments.

Debate teaches a number of invaluable skills, such as how to think and speak quickly and how to defend a position with coherent arguments. Debate helps you develop poise and confidence in your speaking, which can translate into success in the classroom and in college or job interviews. Finally, debate encourages you to think about many sides of an issue, which is necessary to make informed decisions both as a citizen and as a human being.

Robert Warren is the captain of the Normside High School debate team. He is also actively involved in theater, singing, Beta Club, and the NHS Online community. His other interests include strategy games, reading, and political and philosophical discussions with friends.

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Organizing a benefit concert allowed Danielle Kalish to use her love of music in an innovative way: to raise money to help prevent child abuse. Here, she reflects on the project that turned into a public—and personal—success.

IMAGINE: STOP THE PAIN, START THE MUSIC

by Danielle Kalish

In the winter of my junior year, after twelve years of playing the violin, I wanted to use my love of music for something more than solitary practicing. My desire to use music to help people in my community led to the idea to organize a benefit concert. From participating as a performer in other benefit concerts, I knew that such a concert was an effective way to raise money. And from playing violin for so many years, I recognized music's power to evoke emotional responses, to make people care.

Many people warned me that this would be a difficult undertaking and that even some adults have failed to put together successful events like this. Some even suggested that I give up on the project. But I kept in mind that this concert would give me an opportunity to use my musical experience to help an organization about which I care a great deal. I chose a children's charity from the myriad possibilities because children require others to take care of them. Child abuse in particular demonstrates their vulnerability, and its prevention ranks among the most essential efforts in our society. More specifically, I chose the Child Abuse Prevention Center of Maryland because its programs educate both the mothers and the fathers in abusive situations to help entire families survive. To strengthen the concert's connection to this charity, I decided that I would include not only adult but also student performers in the program.

In the fall of my senior year I formally requested permission from my school to use Centennial Hall for the concert date of June 1, 1997. I then formed a committee to help oversee the details of the concert. I quickly learned the necessary behind-the-scenes skills, from the basics of lining up performers and printing programs to the demanding tasks of budgeting and fund raising. I contacted adults with various areas of expertise for advice on the details. Each new piece of information proved to be essential, whether it helped me find a restaurant that would donate food for intermission or a student willing to control the curtains and lighting for the concert.

Danielle performs with BSO Concertmaster Herbert Greenberg

Throughout the organizational process, I had to overcome constant stumbling blocks, both with the logistics of the concert (from simply getting people involved to arranging the program to accommodate the performers) and with the constraints of my hectic schedule. But in resolving the time conflicts between this concert and my other pursuits, such as my senior-year schoolwork and solo violin practicing, I thought of the concert as an integral part of, rather than an obstacle in, my life. The enormous time commitment in organizing this event—including writing grant proposals, making telephone calls to strangers, and calling meetings—only strengthened my dedication.

The concert, which took place more than a year after I started its planning, included a juxtaposition of musical genres. The program featured three vocal performances: two sopranos, Alison Calhoun and Tameika Lunn; and Dayseye, The Bryn Mawr School's award-winning madrigal vocal ensemble. The rest of the program consisted of instrumental music, including performances by violinist Austin Hartman, cellist Kenneth Whitley, and a string quartet. To start off the entire concert, Herbert Greenberg, Concertmaster of the Baltimore Symphony Orchestra, performed as a special guest with me on J.S. Bach's *Concerto for Two Violins in D minor*. Including speeches, intermission, and a raffle, the concert lasted about two hours. A local celebrity, Sally Thorner, co-anchor of WJZ-TV 13, was the emcee, and thanks to her expertise, the concert ran very smoothly.

Although I was busy making sure everything went as planned during the concert, it was amazing to see the event I had spent so much time arranging finally come together. The audience was supportive, and the performers' excitement throughout the afternoon was extraordinary. The concert raised more than $8,000, surpassing my goal of $5,000.

The event was a success for me on not only a financial but also a personal level. I received recognition through both a Governor's Citation and a Mayoral Proclamation. I was also named the 1997 Outstanding Youth Volunteer Fundraiser in the high school category by the Maryland Chapter of The National Society of Fundraising Executives. In addition, I received an Honorable Mention in the Entrepreneurial Spirit competition of the Maryland Chapter of The National Association of Women Business Owners. Most importantly, the concert was the culminating experience of my senior year, as I combined my knowledge of music with my desire to help children.

I hope that my efforts will not only benefit children, but also encourage other young people to do their part in the community. I hope that with the support of their parents, teachers, and peers, they will take the initiative and find a way to extend their individual interests past their daily lives and into the world around them.

Danielle Kalish is now a freshman at Columbia University, where she is active in the orchestra and Women in International Affairs. She continues to take violin lessons in New York City.

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PROJEC

RESCUE

ISION

A Bowie volunteer firefighter tries out the IRIS for the first time.

My brother, Brock, and I started Project Rescue Vision in Spring 1996 after seeing a story on NBC's *Dateline*. The program related how three children died in a fire after firemen, who couldn't see them, crawled right over them. Then the program explained that an Infrared Imaging System (IRIS) might have saved the children's lives. Normally firemen have to locate victims by feeling their way around, but the IRIS allows firemen to see through smoke, fog, and darkness to rescue victims.

At the time of the television program, only three fire departments in the United States had an IRIS device, and unfortunately, our town of Bowie, Maryland, wasn't one of them. Our fire department did not have the $25,000 to buy an IRIS, so Brock and I decided to help buy one for the benefit of our entire community.

The first thing we did was name our effort "Project Rescue Vision." I appointed myself president and Brock vice president. We then applied for and received a trademark for the name from the State of Maryland. We created a logo and promotional phrases such as "Started by kids . . . Run by kids." We got our own post office box and opened a small business savings account. When we learned that we would need a tax-exempt number, we called a local law firm we selected from the phone book for advice. Senator Leo Green happened to be the lawyer we spoke to, and he gave us free advice over the course of our project.

We also contacted the National Firefighters Protection Association for statistics related to deaths and injuries caused by smoke inhalation. We requested information about the IRIS, such as pamphlets, posters, and videotapes, from the manufacturer. With this information, we wrote a letter outlining the goals of Project Rescue Vision to distribute to residents and businesses.

When we started receiving donations, we gathered supplies, such as envelopes, copy paper, record-keeping books, business cards, and T-shirts. We enlisted the help of our family, friends, kids of various ages from preschool to high school, business persons, and city, state, and local officials. We contacted several local newspapers and television stations to inform the community about our project.

Brock and Cory make a s[illegible] to the

During our spring break and summer vacation, we spent an average of five hours a day working on the project. With the help of our volunteers, we colored, stuffed, and handed out thousands of project-information envelopes all around town. We hand-wrote letters to major corporations, visited hundreds of community businesses, gave several speeches, attended various meetings, and obtained media coverage. We organized a huge raffle, solicited businesses for the raffle items, kept records of all donations, and sent out thank-you letters. We made bank deposits, scheduled appearances and events, kept up with incoming and outgoing telephone calls, and maintained an ongoing photo album, diary, and scrapbook.

What does $25,000 look like? Brock, Cory, and McKenzie Snyder display the money raised by Project Rescue Vision.

Cory, Brock, and Project Rescue co[illegible]

We began our project on March 19, 1996, and continued through October 12, 1996. In only four-and-a-half months, we raised the $25,000 needed to buy the

82 BEST COPY AVAILABLE

n before presenting the IRIS ce VFD.

IRIS. While we waited for the IRIS to be manufactured, we planned the dedication ceremony that took place on Fire Prevention Day at Bowie Volunteer Fire Department.

We accomplished our goal of making our local fire department the second in the state of Maryland to be equipped with the IRIS. The local Bowie Fire Department is now equipped with the latest in firefighting technology, which benefits the entire community. Brock and I and the other kids who helped with Project Rescue Vision also benefitted by gaining self-confidence and the knowledge that children can make a difference in the world.

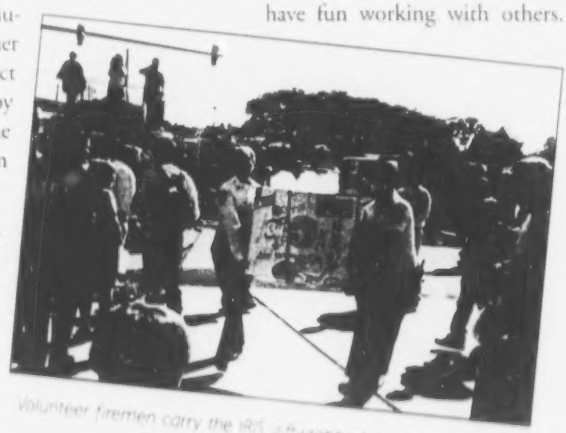
Soon after the IRIS dedication, Brock and I spoke with the fire chief and learned that the fire department still had a critical need for other rescue equipment. Since the department didn't have the funds to purchase what they needed, we decided to continue to help. This time, I was vice president and Brock took over as president of Project Rescue Vision. Our goal was to obtain even more lifesaving equipment.

On Fire Prevention Day 1997, we presented the Bowie Volunteer Fire Department with $10,000 worth of vital equipment: two full state-of-the-art Necessary Self-Contained Breathing Apparatus systems and three gas monitors, one for each station in Bowie.

Vision volunteers open the box the IRIS

With the success of Project Rescue Vision, I realized how important it is to get and stay involved in my community. I am currently volunteering my time at Bowie Cable TV, where I perform duties ranging from those of camera man to floor director. I am putting together my own teen show, which will inform kids of volunteering opportunities in and around Bowie. I hope to air my first show in December.

Brock and I would like to ask each of you to please help out with a need in your community. It can make the difference between having and not having what is needed in our world today—like equipment for a fire department, food for a soup kitchen, clothes for a shelter, or books for a library. We believe that volunteering is a way to fulfill the responsibility we all have to help others. In addition, while volunteering, you can learn many new skills, get to know the people in your community, and have fun working with others.



Volunteer firemen carry the IRIS, all wrapped in paper inside by Project Rescue Vision volunteers.

By doing our project, we learned always to be positive, polite, and never to take no for an answer. We also learned that you can achieve the impossible if you are determined and willing to try.

Brock, 11, and Cory, 13, both enjoy swimming, playing baseball, and participating in Boy Scouts. For his work as president of Project Rescue Vision, Cory was selected as one of the ten National Honorees in the 1997 Prudential Spirit of Community Awards program.

Cory and Brock encourage you to write to them at Project Rescue Vision, 3262 Superior Lane #288, Bowie, MD 20715.

For more information about the Prudential Spirit of Community Awards, visit Prudential's Web site at www.prudential.com/aboutpru/community/apcz1004.html.

Serving Your Community

Danielle Kalish was looking for a way to use her musical ability to help others. Brock and Cory Snyder recognized a need in their community. From such simple motivations, incredibly successful volunteer efforts were launched.

The first step toward making a difference in your community is to identify a need you want to meet. Perhaps you're concerned about homelessness, pollution, or crime. Or maybe you think your local library needs more updated resources, or that the kids in your neighborhood would benefit from a youth recreation center. No matter what concern you choose, you'll need to think of solutions in very specific terms. For example, you might make an impact on crime in your area by setting up a neighborhood watch; you can help purchase library resources by helping to raise money.

Before you begin work on your project, you'll want to do some research. Find out if any organizations in your area are already working on the problem; if they are, you might consider working with them. If you'll be starting your own project, you'll need to do even more research.

Whether you want to join an organization, start a new chapter of one that's already established, or found your own, John W. Bartlett's *The Future is Ours: A Handbook for Student Activists in the 21st Century* (Henry Holt and Company, 1996) is a great place to start. This book includes advice on everything from getting organized and working with the media to raising funds and keeping momentum. A useful resource directory lists organizations you can contact for more information.

Take a look around your community to see how it needs your time, talent, and energy. Even if you have only a couple of hours a month to donate, you'll find numerous ways to make positive changes. Ask your guidance office about volunteer opportunities in your area; call local hospitals, libraries, churches, nursing homes, and shelters; or contact organizations such as SADD and the Red Cross to find out how you can make a difference.

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Exploring Career Options: Robotics

Interview with Greg Chirikjian

by Carol Blackburn

The term "robot" was coined not by a scientist but by a playwright. "Robota"—Czech for "servitude"—first appeared in Karel Capek's 1917 play about artificial humanoids built for use as servants. Greg Chirikjian***'s fascination with robotics has been fueled by a lifetime of watching the film and television successors of Capek's creations. After completing degrees in mathematics and mechanical engineering at Johns Hopkins and a Ph.D. in applied mechanics at Caltech, Chirikjian returned to Hopkins to become one of its youngest and most popular engineering faculty members.***

I believe you are our first interviewee to admit that his career dreams were inspired by The Six Million Dollar Man.

It's true. When I was a kid, science fiction shows kindled my imagination. I enjoyed thinking about whether those futuristic devices could really be built. When I was seven or eight, I tried to build a robot like the one on *Johnny Sako and his Flying Robot*—a 1960s TV show with bad special effects. I've always liked to work with my hands, and I've always been interested in building gadgets with futuristic sorts of applications. So it was natural for me to tie my interests together by studying engineering.

When did you start your more formal research in robotics?

My master's thesis at Johns Hopkins concerned the dynamics of motion of a satellite's extendable arm. The arm was folded very tightly, but could unfold, popping out into a long structure. How would it move during that unfolding? My research on that problem initiated my interest in the geometry of motion of devices with many joints, an interest that continues to the present day.

It sounds as though your work involves considerable mathematics as well as engineering.

In robotics, more than in most engineering fields, you study motion and relationships between objects in space. When you examine such phenomena in any detail, the analysis becomes very mathematical. All the physical laws we know are based on calculus. In fact, at the graduate level, most engineering courses are applied math: the mathematics of how a fluid flows, or of how a solid deforms when forces are applied to it, or of how an object vibrates. Math also plays a role in the computer programming component of robotics: at the core of any program is an algorithm, and at the core of any algorithm is math. Mechanical engineering certainly includes a large experimental component, but I've found my knowledge of mathematics to be the most valuable skill I have in my work.

Could you tell us more about many-jointed devices and why they interest you?

Let me step back and give you some context. My work is at the very basic end of the research spectrum, especially for an applied field like robotics. Robots are already in use in industry, and some people study how to improve existing robots. I prefer to ask, "What comes next? What will be the next jump in robotic evolution?"

Two problems that currently limit the use of robots are cost and lack of versatility. Most robots are designed for a specific task. When a company changes its product, as, for example, General Motors does every year, last year's robots may become obsolete—turning into expensive junk.

One reason contemporary robots are so expensive is that they require sophisticated control systems. Robots have historically been made of components—joints and motors—that produce a continuous range of motion. That flexibility may sound desirable, but it's actually a liability: because of it, a robot requires a complex control system to direct its movements and a complex feedback system to monitor precisely where its moving parts are at all times. For most things robots do, they need to reach only a small number of fixed locations. So for most robots, a continuous range of motion is overkill, needlessly adding to the complexity required of their control systems.

As an alternative, I'm designing robots with what I call "binary actuators." Each joint has only two states: it can go to either one angle or another. Using many of these together, we can create robots capable of reaching many locations and of executing complex motions (we've made snake-like binary-actuator robots that slither with the best of them). However, since the binary joints limit the robot's movements, a lot of positional control is built into the joints—the hardware—so the robot requires a much less complex control system.

How does your work address the problem of versatility?

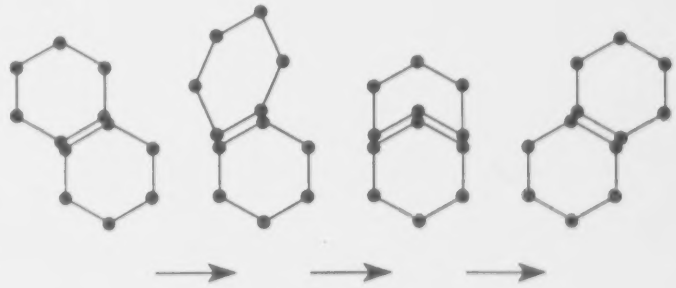
This is my other major research area, which was actually inspired by the movie *Terminator 2*. A fluid-metal-alloy robot is obviously out of the question, but *T2* got me thinking about the possibility of metamorphic—that is, "shape-changing"—robots.

Today's robots are fixed in form: you can't remove a finger and reattach it somewhere else. I started thinking about a robot composed of many small modules, each with the ability to move relative to its neighbors. Such a system would have the ability to self-reconfigure—to begin as one shape and become a completely different one.

Metamorphic robots would have innumerable uses. Imagine, for example, a truck full of modules pulling up to a building that collapsed in an earthquake. The modules could migrate into the building, then reconfigure to form a buttress, shoring up the structure so rescue workers could safely enter.

Of course, it takes a while for a concept to go from the drawing board to the initial prototype stage—which is where we are now—to a commercial product. It may take ten or twenty years of work before we have a robot that can go into an environment like a collapsed building.

At this point, we're still working on the basic shape-changing control of the robot, developing algorithms to organize the movements of modules needed to transform a robot from one shape to another. After these sorts of basic problems are solved, we can think about equipping the modules with sensors (so they can "see" in that collapsed building).



"Walking" Hexagon

How did you come up with the design for your metamorphic robot's basic module?

Once I knew the properties I wanted the modules to have, it wasn't really that hard. To keep things simple, I chose to limit the modules and their movements to two dimensions. (We'll tackle three dimensions after we work out the bugs in our two-dimensional prototypes.) There are only three regular shapes that can fill a planar space: an equilateral triangle, a square, and a regular hexagon. Of those, only the hexagon has enough flexibility to "walk." Geometry allowed me to identify the most appropriate shape to use.

What do you mean by "walk"?

Each hexagonal module has a motor at each vertex that can change the angle at that vertex. By specifying the angles, you control the shape of the hexagon. We can change the angles, causing a hexagon to deform enough that it simultaneously touches another hexagon along two edges. Two hexagonal modules can start out attached along one edge, then become attached along a second edge, at which time the initial link can be released. When the "walking" hexagon regains its original shape, it moves into an adjacent space. The modules thus remain linked at all times, but the overall form changes.

It's interesting that you were inspired by a humanoid robot—T2—but ended up with a completely different sort of structure.

Many robotic devices are modeled on biological forms. But just because a biological structure has survived evolutionarily doesn't mean it's the optimal structure for the task it now performs. The human form has evolved from earlier forms, and its architecture carries baggage from its past.

That's why I try to create robots that are very non-anthropomorphic. In engineering, we don't have to carry baggage; we have the luxury of starting from scratch. I can consider what a robotic device will be used for and ask, "What traits would a robot need to perform this task?" Then I try to develop the best design.

What do you find most satisfying about your work?

I enjoy the pleasure of visualizing an idea, then implementing it—of creating something I can see and hold that actually works and moves.

I also enjoy the satisfaction of knowing two disciplines well enough to be able to draw connections between them, then to transfer knowledge from one to the other. I think the most interesting work always occurs at the border of two (or more) fields. Doing traditional work in a field is valuable, but making connections that didn't exist before is, I think, even more important.

I also enjoy talking to colleagues in different realms of science, trying to find connections between their worlds and my own, looking for new applications for the ideas I'm working on. When you do research in more than one field, it becomes easier to see connections not only *between* those fields but *beyond* them, in other fields, as well.

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How should aspiring roboticists pursue their interests educationally?

Robotics research requires the combined expertise of scientists from several disciplines. Mechanical engineering, electrical and computer engineering, computer science, even biomedical engineering can all prepare you to work in some facet of robotics.

Multidisciplinary teamwork is required not only in robotics but in much of engineering in the real world. It is, therefore, surprising that engineering undergrads are given very little opportunity in their classes to work collaboratively with other kinds of engineers. They don't get a full picture of the pleasures or challenges of a lot of professional engineering.

To give students such an opportunity, I teach a project-oriented course in "mechatronics"—the integrated use of mechanical engineering, electronics, and computer programming. Small groups of students are given a project that no one of them has all the skills to complete. They must parcel out the tasks among themselves, deciding who will do the programming, who the mechanical design, and who the electronics. They have to develop a working communication among themselves if the project is to come together.

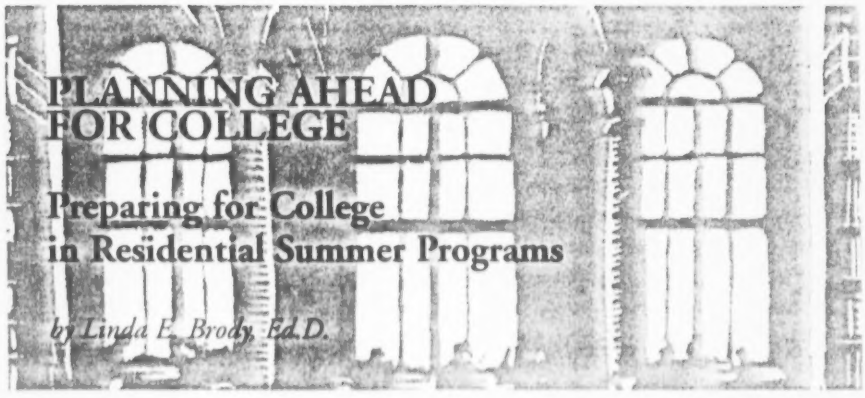
Do you have any final words for students considering engineering?

Perhaps just a word of caution. Some of my undergraduate students don't seem to appreciate the importance of learning math. "If the computer can calculate the area under a curve for me, why do I need to learn calculus?" they ask. "Because it's not enough to obtain the correct answer; you need to understand *why* it's correct," I reply. To have a firm footing in engineering, you must master the math that underlies it. ■

Selected Resources

Dr. Chirikjian's home page
caesar.me.jhu.edu/

Robot Information Central
www.robotics.com/robots.html



PLANNING AHEAD FOR COLLEGE

Preparing for College in Residential Summer Programs

by Linda E. Brody, Ed.D.

What are your plans for this summer? Will you take a class? Travel? Seek a summer job? Or use the summer to read and explore topics on your own? The choice of summer activities during your precollege years deserves as much consideration as your classes in school. Though summer may feel far off, it is definitely time to think about what you want to do before deadlines pass and opportunities diminish.

Summer is a wonderful time for learning. You can study subjects that aren't available—or that you don't have time for—during the school year. You can do this in a formal classroom setting or in less structured ways. Whatever your choice, taking advantage of opportunities that extend beyond the school year will enable you to have a broader academic background when you enter college. And including your summer experiences on your college application may make you a stronger candidate for admission.

If your plans this summer include taking a course or two, consider the advantages of a residential program held on a college campus. The talent searches have a long history of offering advanced course work to academically talented students in programs held at various colleges, and the concept has spread so that precollege students heading to class with books in tow are a common sight in the summer on many college campuses.

Residential summer programs offer solid academic course work and much more. You can immerse yourself in rigorous academic content in the company of your intellectual peers while improving your study skills, enhancing your motivation, and preparing yourself for the academic challenge of college life.

Living on your own in a college setting can also help develop self-reliance and independence. In most programs, you will live in a dormitory, be responsible for your personal needs such as laundry, and become involved in a variety of social activities. If you spend one or more summers in this environment, you will enter college knowing that you can excel in advanced-level course work, live away from home, and make new friends in a short period of time.

Spending time on a college campus through a residential summer program can also help you in your college search. Even if you have no interest in attending the college at which you spend your summer, you can use the experience to identify characteristics that are important to you. Are you likely to be more comfortable on a large or small campus? Do you prefer an urban, suburban, or rural environment? Is there something special you would want in terms of living arrangements or dining facilities? What about special facilities such as computers, laboratories, libraries, or a museum on campus? A summer on a college campus can help you answer such questions about the type of environment in which you want to spend your undergraduate years.

The next pages provide a list of some of the best academic summer programs in the country. Others can be found in the books listed as references (especially *Summer on Campus*) and on the Web. If you are interested in a particular campus, you can contact that institution directly.

It can be overwhelming to think about all the options for summer. Travel, reading, volunteering … all are exciting possibilities. All offer opportunities to learn and grow. All can enhance your preparation for college. But an academic summer program can allow you to live and study on a college campus—an experience that will increase your confidence in your ability to navigate the demands of college life. ■

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Selected 1998 Academic Summer Programs

Many opportunities exist for you to continue to challenge yourself academically during the summer. We have received positive reports from participants about the programs listed below.

Space in many summer programs is limited, so we suggest you apply early. You'll want to inquire about qualification requirements, course options, dates, fees, and scholarship availability. Grades specified refer to students' current grade level.

IAAY ACADEMIC SUMMER PROGRAMS

Center for Academic Advancement (CAA)

Grades 7–9, 3 weeks, residential sites in CA, MD, and PA.

Center for Talented Youth (CTY)

Grades 7–10, 3 weeks, residential and commuter sites in CA, MD, NY, and PA.

CTY Young Students

Grades 2–6, 3 weeks, commuter sites in MD and VA. Grades 5 & 6, 3 weeks, residential sites in CA, CT, and MD. *IAAY Summer Programs, The Johns Hopkins University, Baltimore, MD 21218; (410) 516-0277 or (818) 500-9034.*

SDB Learning Center

Grades 4–6, 4 weeks, commuter site in CA. *SDB Learning Center, IAAY, The Johns Hopkins University, 206 N. Jackson Street, Suite 304, Glendale, CA 91206; (818) 500-9034.*

OTHER TALENT SEARCH PROGRAMS

Center for Talent Development

Grades 4–12, 3 weeks, residential and commuter. *CTD, Northwestern University, 617 Dartmouth Place, Evanston, IL 60208; (847) 491-3782.*

Duke University Talent Identification Program

Grades 7–10, 3 weeks, residential. (See also Study Abroad.) *Duke University TIP, Box 90747, Durham, NC 27708-0747; (919) 684-3847.*

Rocky Mountain Summer Institute

Ages 10–15, 2 weeks, commuter. Ages 12–16, 3 weeks, residential and commuter. *Rocky Mountain Talent Search, University of Denver, Wesley Hall-Room 203, 2135 East Wesley Avenue, Denver, CO 80208; (303) 871-2983.*

ADVANCE Program for Young Scholars

Grades 7–11, 3 weeks, residential. *Programs for the Gifted and Talented, Northwestern State University, P.O. Box 5671, Natchitoches, LA 71497; (800) 259-3173 (within state); (318) 357-3174 ext. 105.*

Academic Talent Search and Accelerated College Entrance Center

Grades 6–9, 1–5 weeks, commuter. *ATS, California State University-Sacramento, 6000 J Street, Sacramento, CA 95819-6098; (916) 278-7032.*

Belin-Blank Center

Grades 6–8, Junior Scholars Academy; grades 9–11, National Scholars Academy, and Summer Institute for Creative Engineering and Inventiveness. One week, residential. *Belin-Blank International Center for Gifted Education and Talent Development, The University of Iowa, 210 Lindquist Center, Iowa City, IA 52242; (319) 335-6148 or (800) 336-6463.*

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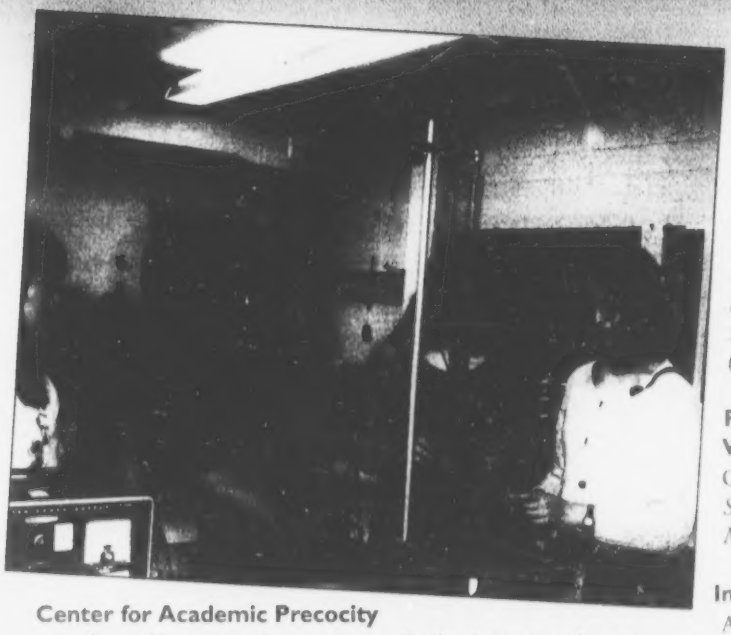

Center for Academic Precocity
Grades preK–11, 5 weeks, commuter. Grades 6–11, 5 weeks, residential. *CAP, Arizona State University, Box 872711, Tempe, AZ 85287-2711; (602) 965-4757.*

Center for Gifted Studies
Grades 7–10, 3 weeks, residential. *The Center for Gifted Studies, University of Southern Mississippi, Box 8207, Hattiesburg, MS 39406-8207; (601) 266-5236.*

Office of Precollegiate Programs for Talented and Gifted
Grades 7–9, Explorations, 1 week. Grades 7–10, CY-TAG, 3 weeks. Grades 10–11, Iowa Scholars Academy, 4–8 weeks. Residential and commuter. *OPPTAG, W172 Lagomarcino Hall, Iowa State University, Ames, IA 50011-3180; (515) 294-1772.*

Purdue University Gifted Education Resource Institute
Grades 7–8, Star; grades 9–12, Pulsar; Nova college credit; 3 weeks. *Summer Residential Programs, Purdue University GERI, 1446 LAEB, Room 5114, West Lafayette, IN 47907-1446; (765) 494-7243.*

Southern Methodist University Gifted Institute and Precollege Programs
Grades 7–9, 3 weeks. Grades 10–11, 5 weeks. Residential and commuter. *SMU/TAG, P.O. Box 750383, Dallas, TX 75275-0383; (214) 768-5437.*

Summer Program for Verbally and Mathematically Precocious Youth
Grades 7–10, 3 weeks, residential. *VAMPY, The Center for Gifted Studies, Western Kentucky University, One Big Red Way, Bowling Green, KY 42101-3576; (502) 745-6323.*

Summer Stretch
Grades 7–9, 5 weeks, commuter. *Halbert Robinson Center for the Study of Capable Youth, University of Washington, Box 351630, Seattle, WA 98195-1630; (206) 543-4160.*

Wisconsin Center for Academically Talented Youth
Grades 5–6, 1 week, residential. Grades 7–12, 3 weeks, residential. *WCATY, 2909 Landmark Place, Madison, WI 53713; (608) 271-1617.*

HUMANITIES AND THE ARTS

Concordia Language Villages
Ages 7–18, 1–4 weeks, residential. *Concordia Language Villages, 901 South Eighth Street, Moorhead, MN 56562; (218) 299-4544, (800) 247-1044 (within state) or (800) 222-4750 (out of state).*

Foreign Language Institute, and Writing & Thinking Workshop
Grades 9–12, college credit, residential. *Foreign Language Institute, Simon's Rock College of Bard, 84 Alford Road, Great Barrington, MA 01230-9702; (413) 528-7227.*

Interlochen Arts Camp
Ages 8–18, 8 weeks, with 4-week option for grades 3–9, residential. *Admissions Office, Interlochen Center for the Arts, P.O. Box 199, Interlochen, MI 49643-0199; (616) 276-7200.*

Boston University Tanglewood Institute
Ages 14–18, 2- to 8-week sessions emphasizing music, residential. *Boston University Tanglewood Institute, 855 Commonwealth Avenue, Boston, MA 02215; (617) 353-3386.*

MATHEMATICS

Program in Mathematics for Young Scientists
Grades 9–11, 6 weeks, residential. *PROMYS, Department of Mathematics, Boston University, 111 Cummington Street, Boston, MA 02215; (617) 353-2563.*

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Ross Young Scholars Program*

Ages 14-17, 8 weeks, residential. *Ross YSP, The Ohio State University, 100 Mathematics Building, 231 W. 18th Avenue, Columbus, OH 43210; (614) 292-1569.*

** NSF-sponsored program. To learn about other subsidized science and math Young Scholars Programs, call the National Science Foundation: (703) 306-1616.*

STUDY ABROAD

CTYI, Dublin

Ages 12–16, 3 weeks, residential. *The Irish Centre for Talented Youth, Dublin City University, Dublin 9, Ireland; 353-1-7045634; fax 353-1-7045693.*

Duke TIP International Summer Study Trips

Grades 8–11, 3 weeks: England, Germany, and Italy. *Duke University Talent Identification Program, Box 90747, Durham, NC 27708-0747; (919) 684-3847.*

International Summer Science Institute

Grade 12 with independent research experience, 5 weeks, study and travel in Israel. *International Summer Science Institute, American Committee for the Weizmann Institute of Science, Suite 117, 51 Madison Avenue, New York, NY 10010; (212) 779-2500; fax (212) 779-3209.*

Oxbridge Academic Programs

Ages 14–18, 4 weeks, England and France. *Oxbridge Academic Programs, 601 Cathedral Parkway 7R, New York, NY 10025-2186; (800) 828-8349 or (212) 932-3049.*

OTHER RESOURCES

For additional academic summer programs, ask about precollege programs at local colleges and universities, search the Web, and consult these guides:

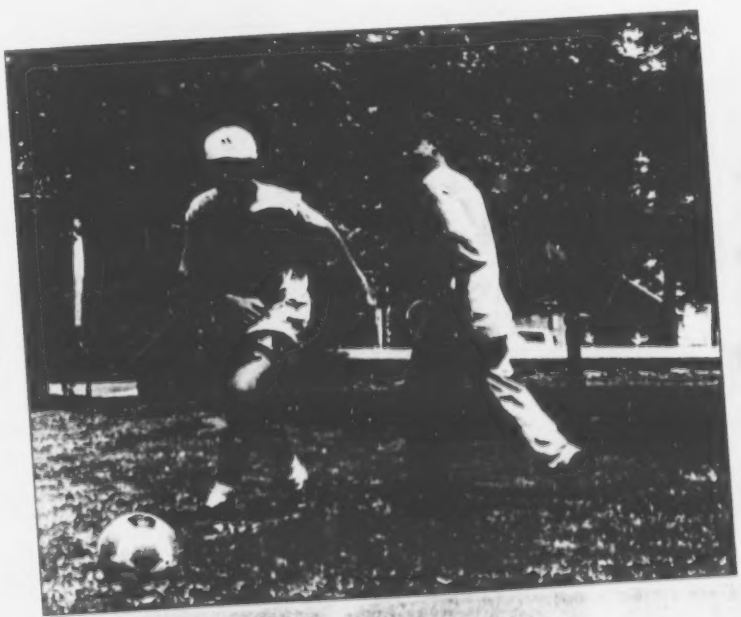
Advisory List of International Educational Travel and Exchange Programs 1997-98 ($15.00)
Council on Standards for International Educational Travel, 3 Loudoun Street SE, Leesburg, VA 20175; (703) 739-9050.

Educational Opportunity Guide: A Directory of Programs for the Gifted (1998, $15.00)
Duke University Talent Identification Program, P.O. Box 90780, Durham, NC 27708-0780; (919) 683-1400.

Program Opportunities for Academically Talented Students (1998, $12.00)
IAAY Office of Public Information, The Johns Hopkins University, 3400 N. Charles Street, Baltimore, MD 21218; (410) 516-0245.

Summer on Campus: College Experiences for High School Seniors (1995, $15.00)
Available in bookstores or from College Board Publications, Department A40123, Box 886, New York, NY 10101-0886.

Summer Opportunities for Kids and Teenagers (1998, $26.95)
Available in bookstores or from Peterson's Guides, P.O. Box 2123, Princeton, NJ 08543-2123; (800) 338-3282.



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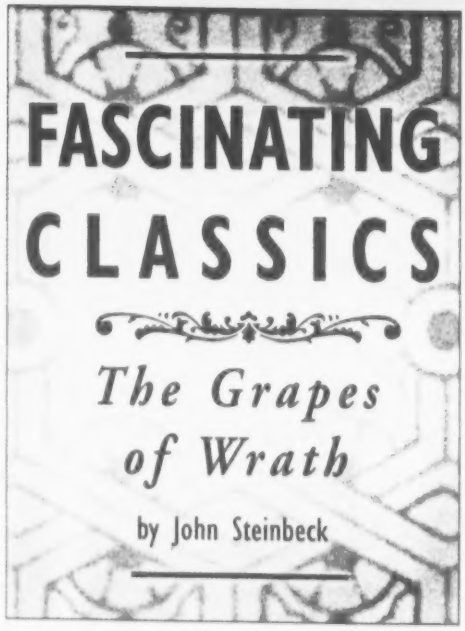

Review by
Michael Henry & Lesley Mackay

Michael: Lauded as his best work, Steinbeck's *The Grapes of Wrath*, which won the Pulitzer Prize in 1940, is rich in character, powerful in imagery, and moving in its portrayal of the human spirit during one of the most trying eras in American history. In the 1930s, the economic disaster of the Great Depression was worsened in the southern plains states by the natural devastation of the Dust Bowl. *The Grapes of Wrath* explores one family's struggle to survive these crises. The novel focuses on the experiences of the Joads as they give up their Oklahoma farm and migrate west, lured by the promise of work in fertile California.

Lesley: The book can be viewed as a road novel that incorporates a vast chunk of the American landscape, with its endless highways and open spaces, as its backdrop. Steinbeck's main characters are three generations of the Joad family—frail, overwhelmed grandparents; the stoical but disillusioned Pa Joad; the loving but tough-as-nails Ma Joad; and a colorful set of siblings, including Tom Joad, a principled ex-convict; Rose of Sharon, a sensitive young woman who is pregnant; and Winfield and Ruthie, both children.

Forced off their land, the Joads and a family friend, ex-preacher Jim Casy, cross the country in a single covered truck that also carries all their possessions. They begin their hard journey battered by brutal, impersonal forces—drought and dust storms, a stagnant economy, and the greed of wealthy corporate farmers. Joining hordes of other people on the great east-west Highway 66, the Joads are part of an exodus that is Biblical in scope:

> *66 is the path of a people in flight, refugees from dust and shrinking ownership, from the desert's slow northward invasion, from the twisting winds that howl up out of Texas, from the floods that bring no richness to the land and steal what little richness is there. From all of these the people are in flight, and they come into 66 from the tributary side roads, from the wagon tracks and the rutted country roads. 66 is the mother road, the road of flight.*

Michael: As he documents the Joads' migration, Steinbeck examines the capitalistic system that helped drive them out of Oklahoma and that faces them again as they try to resettle in California.

In an environment of unbridled capitalism, Steinbeck finds much that is amoral and even cruel—the exploitation of laborers, the manipulation of wages, and the inaccessibility of basic goods, such as food. Steinbeck draws the reader's attention to disturbing paradoxes: in his novel, people starve while meat and milk spoil and mountains of fruit are left to rot so that corporations can keep the price of food artificially high.

However, *The Grapes of Wrath* is as philosophical as it is socially and politically passionate. Steinbeck's most powerful characters demonstrate a calm perseverance. Tom and Ma Joad take life one day at a time. Casy, having given up preaching to live in humility and friendship with others, denies the existence of good or bad luck, explaining that a man "got to do it all hisself." Through it all, Steinbeck's simple agrarian folk demonstrate tremendous patience and resolve.

Lesley: They do so despite the darkness that surrounds them. In the beginning of the novel, this darkness, both allegorical and real, is rendered through the powerful imagery of the Dust Bowl:

> *Little by little, the sky was darkened by the mixing dust, and the wind felt over the earth, loosened the dust, and carried it away. The wind grew stronger. The rain crust broke and the dust lifted up out of the fields and drove gray plumes into the air like sluggish smoke. The corn threshed the wind and made a dry, rushing sound. The finest dust did not settle back to earth now, but disappeared into the darkening sky.*

Steinbeck is a great naturalistic writer, and his primary theme is the need for people to live in harmony with nature. However, his perspective on the natural world is not sentimental, and he makes it clear that at times nature can be man's greatest enemy.

Michael: Yet Steinbeck suggests that in community people can survive almost anything. For example, on the road to California, the

The Historic Crises Behind Steinbeck's Novel

The Dust Bowl of the 1930s encompassed 150,000 square miles of land in Kansas, Colorado, New Mexico, Oklahoma, and Texas. For decades before, the soil of this region had been enormously strained by the aggressive grazing, planting, and harvesting that characterized westward expansion in the United States. These pressures combined with typically high temperatures and low rainfall to accelerate the process of soil erosion.

Then, from 1933 to 1939, a drought devastated the southern plains states, and seasonal high winds blew layers of loosened earth into the sky, creating vast clouds that came to be known as "black blizzards." The dry storms not only whipped dust into the atmosphere, but also swept it into dunes up to 30 feet high that dotted the useless farmland of the Dust Bowl region.

The federal government, long active in the development of the West, responded actively to the disaster, planting grass and trees, and teaching farmers to let some of their fields lie fallow in order to store moisture in the soil. The Dust Bowl subsided by 1941, after an intensely difficult period also

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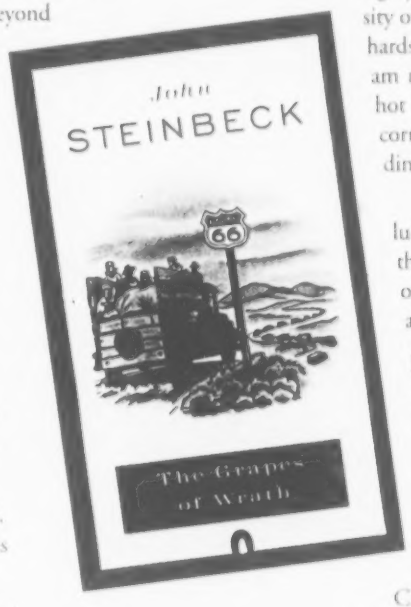
Joads reach out and help others in need, even though they have very little to give. In so doing, they achieve a sense of solidarity with others that proves to be a kind of salvation. Later, when the family arrives in California, they find and briefly join a democratically-run migrant community and feel joy as members of a cohesive group that supports and respects individual dignity.

When Ma Joad arrives in this camp, she exclaims, "Why, I feel like people again." Steinbeck depicts the residents of this humane environment experiencing a kind of rebirth as life moves beyond survival and they are reawakened to the desire to share, to play, to tell stories, and to make music. One night, a camp resident realizes, "the stars are close and dear and I have joined the brotherhood of the worlds. And everything's holy—everything, even me."



Lesley: Steinbeck works from these priceless instances of community to a dramatic climax in which Tom Joad and Jim Casy risk their lives to help form a union of migrant laborers. Creating the union is an urgent matter for the thousands of migrant families: until workers are organized, they compete with each other for jobs, allowing the landowners to bid wages so low that the workers cannot buy food.

Tom Joad and Jim Casy are unruly but principled, and tough but caring antiheroes. I think of them as brothers, although they are not.

Michael: I agree with you, Lesley, that Casy and Tom make powerful, unconventional leaders. However, I think that the strengths of the Joad women are even more striking. In the course of Steinbeck's narrative, a shift takes place among the Joads, and the family structure changes from patriarchal to matriarchal.

At the head of the new social order is Ma Joad. She holds the family together as they drive across the country and, once they arrive in California, as they struggle to establish a home and obtain work. So dedicated is Ma that, one night, determined not to slow the family down as they cross the desert into California, she silently comforts Grandma as the older woman dies in the back of the family truck. Upon realizing that she bore this ordeal alone, "The family looked at Ma with a little terror at her strength...." Afterward, Ma is offered a seat in the previously male bastion at the front of the truck.

Lesley: That's a great point, Michael. While Tom and Jim become political leaders, the Joad women urge the family and others on as they meet the tremendous challenge of survival. While I admire the novel's masterful evocation of social, political, and economic realities, I think that its tale of staying alive moved me most. The novel has a highly visual and tactile quality. In the gritty intensity of its descriptions, it brilliantly evokes terrible hardship. Reading it, I can easily imagine that I am riding under the tarps with the Joads down hot highways, the gas meter on empty, or eating corn mush and a couple of green peaches for dinner after a hard day's work in an orchard.

The Grapes of Wrath reminded me how lucky I am, and made me think about the thousands of people who still work on farms on a seasonal basis, and who must worry about feeding their families.

Michael: The novel definitely does arouse compassion and respect. To me, though, it also buoyantly upholds the American dream and the impulse to fight for a better life. Tom and his family survive their westward journey in part because they are inspired by the mythic image of California's fertility and beauty. Later they learn that California's vast natural wealth is controlled by banks and the rich and that the family must face just as much adversity there as they had escaped in Oklahoma. However, they refuse to give in to despair, and the end of the novel finds them as determined as ever to survive and prevail. To me, the Joads' nobility of character, as demonstrated by their persistence and hope, is the ultimate strength of *The Grapes of Wrath*. ■

Lesley Mackay

Michael Henry

marked by the Great Depression, the most severe economic crisis in American history.

However, as Steinbeck describes in *The Grapes of Wrath*, this tough episode brought not only instability and suffering, but also a new era of political commitment and organization. Under Franklin D. Roosevelt, the government created an array of programs intended to aid and educate citizens and to foster economic progress. And Steinbeck's fictional Tom Joad and Jim Casy illustrate the growth of a significant political movement: In 1935, the National Labor Relations Act made it easier for workers to advocate for their own rights, and from 1932–1941 union membership in the United States rose from three million to ten million.

Upcoming Fascinating Classics:

Virginia Woolf, *To the Lighthouse*
Ernest Hemingway, *The Old Man and the Sea*

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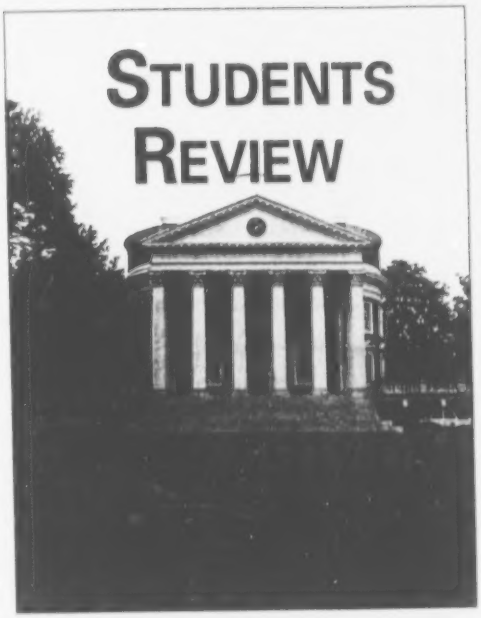
STUDENTS REVIEW



The College Review Series is intended to aid prospective college students in their search by offering insiders' views of selected colleges and universities, as expressed by current undergraduates or recent graduates who have high academic ability. Note that the number of reviewers is small. Consider their personal perspectives as only one component as you gather information and impressions from many sources.

Our reviewers include fifteen students, who major(ed) in biology (2), chemistry (1), foreign affairs (2), government (1), history (2), math (3), philosophy (1), physics (1), psychology (2), Russian studies (1), and systems engineering (1). (The number of majors exceeds fifteen because some students completed double majors.) Students' comments appear within quotation marks.

Quality of Academic Instruction for Undergraduates

Perhaps no other university can boast such a distinguished origin. Founded by Thomas Jefferson, who designed the Grounds (that is, the campus) and the original buildings, UVA continues to promote the values of learning, self-governance, and public service that inspired Jefferson.

"What I liked best academically about UVA is the emphasis placed on teaching undergraduates. While research and scholarship are acknowledged to be important, the administration has made it clear that faculty are expected to teach undergraduates and ***teach them well.*** *Some of my first-year classes were large, but even then, I found the faculty to be very approachable and eager to interact with curious students. All my professors taught with great enthusiasm, truly demonstrating a love of teaching. The faculty is definitely one of the school's best attributes."*

"My academic experience at UVA was tremendous. The faculty is ***very*** *undergraduate-friendly and keenly interested in cultivating the cream of the undergraduate crop. I wrote a thesis with a nationally-renowned scholar who dedicated a few hours a week to my project. Graduate-level courses are also open to qualified undergrads. I took four graduate seminar courses that met entirely in the living rooms of distinguished Government and Foreign Affairs faculty members."*

"A feature that makes UVA especially attractive is the Echols Scholars Program. The top 10% of students accepted into the College of Arts & Sciences are given the title of Echols Scholar, which removes them from all distribution requirements; they don't even have to major. Using this privilege, Echols Scholars can really pursue their own interests, creating a curriculum that fits them uniquely."

"Echols Scholars have priority in registering for courses, giving them unfettered access to the best classes at UVA—which can, I think, hold their own with those at just about any school. With Echols, you can consistently find superb teachers."

"While the quality of instruction varies, every department has some ***outstanding*** *teachers. UVA's best undergraduate programs include those in the schools of Architecture, Commerce, and Education and the departments of Systems Engineering, Computer Science, History, English, Government, Foreign Affairs, Religious Studies, and Spanish. UVA also has a large internship program; during their fourth year, students can earn four credits per semester working in their field of choice. As for 'gut' classes, there are few, and at UVA a gut only means an easy B, not an A."*

Social Life

The vibrant extracurricular life and strong sense of history make the UVA experience distinctive.

"One of the school's greatest assets is the positive attitude that pervades the student body. Most people are very happy to be here. The University has a conservative, historic, Southern feel to it, but many kinds of people can find a niche. The school boasts a very strong Greek community, tons of student-run activities, a strong intercollegiate athletic program, and one of the best intramural programs in the country. Charlottesville is a beautiful town nestled in the Blue Ridge foothills, in horse country, only an hour or two from Richmond and Washington, D.C. The surrounding area offers many places to go hiking, camping, or rock climbing."

"For me, the quality of life at UVA is the school's greatest selling point. We support a daily newspaper, a weekly magazine, and at least ten other completely student-run publications. The Jefferson Society, the oldest organization at UVA, hosts a Friday night lecture series, after which discussion and debate continue until the early hours of the morning. The University has a strong history of student self-governance. Our student-run Honor System is a model for other honor systems across the country, and the Student Council is very active in promoting the quality of student life, participating in much of the decision-making around the University. We also have over 300 student organizations, including many religious and service groups."

"Very few students who graduate from UVA do so without having given back to the community. The largest organization on Grounds, Madison House, is dedicated to supplying volunteers to the local area. Service organizations and fellowship groups abound, especially for evangelical Christians."

"School traditions provide experiences that unite the student body, creating a strong and enduring sense of community. Going to a football game in a jacket and tie is great fun, and makes for a handsome sight to see. UVA has a history of which it is very proud, yet it's not unwilling to change. Tradition is important here, but it does not overwhelm reason."

"UVA's Southern hospitality fosters a cordial atmosphere; decorum definitely counts around here. Consequently, UVA looks conservative and homogeneous. However, there are plenty of left-of-center and unconventional students; they just aren't as outwardly defined as at many other schools. With organizations from the Honor Committee to the punk rock radio station, almost any undergrad can find like-minded friends."

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"As a member of the Greek system, I recognize its problems: noise, an abundance of alcohol, and some 'old-boy' attitudes. However, I would encourage prospective students to consider UVA's reputation as a party school with rational caution rather than paranoia. First, the frats are geographically isolated. If you don't like them, don't go. Second, only about 35% of UVA's students are in the Greek system. Non-Greek organizations offer an extraordinary range of social activities and opportunities. Finally, even among Greeks, there is very little peer pressure to drink if you don't want to do so."

What Do You Like Best about UVA?

Reviewers appreciate the congenial atmosphere, diverse opportunities, and lovely campus. The historical context is also meaningful to many.

"Mostly, the fact that UVA is a friendly university. People—professors, students, head residents—are always ready to help. Profs are more than willing to work one-on-one with gifted students. In addition, the leadership skills I developed in my extracurriculars meant as much to me as the knowledge I gained in my classes."

"Like most college grads, I treasure the friends I made in college and the precious memories from those years: walking home in my stocking feet after a sorority formal, tailgate picnics, the semiannual Foxfield steeplechase, strolling the Lawn at night, the pervasive sense of history. On the practical side, I landed a job right out of school after an interview that consisted of my interviewer reminiscing about UVA."

"I spent my last year at UVA living on the Lawn, an honor given to outstanding fourth-year students. Living amidst the sense of history of that place was an experience I will always cherish. Jefferson was an incredibly talented man who had an extraordinary educational and architectural vision, and who made it a reality. UVA was founded on the basis of his ideals, and I think there really is a concerted effort to live up to those ideals. At the same time, we are all aware that he had inconsistencies in his life, as any complex person will. The Lawn was built by slaves, and their contribution to UVA's history must be recognized as well as Jefferson's."

What Do You Like Least about UVA?

Some found the weekend partying excessive.

"The **Greekness**, *with the associated drinking, noise, litter, and moronic behavior. It's not that I don't enjoy a bit of that kind of fun, but there's just too much of it."*

"UVA is an awfully easy place to become an alcoholic. Our student nickname, 'wahoo,' refers to a species of fish that can drink its own weight in water in a day. Some UVA wahoos try very hard to match that feat at keg parties."

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"The strong sense of school pride can lead to a kind of smugness. 'Hoos can be a bit, well, pretentious about their school."

"The student body is only moderately multicultural. The average student is still white and comparatively conservative. You can, however, find any and every kind of person if you look."

Who Would Be Most Compatible with the Academic and Social Atmosphere at UVA?

"UVA's beautiful setting, exceptionally wide range of extracurricular activities, superior academic programs, nationally ranked athletic teams, and strong traditions of honor and self-governance give the school an enormously broad appeal. Students flock to Charlottesville for many reasons, but most appreciate the school's uncanny ability to engage simultaneously the heart, soul, and intellect."

"Someone confident and outgoing, who wants academic challenge and bright peers, but whose goal is to live a full life, in which academics are simply one facet. Wahoos relish all aspects of life: putting out a terrific newspaper, hiking the Appalachian Trail, and wild exploits with friends, as well as arguing over the exact nature of Petruchio and Kate's relationship."

"As a kid, I loved watching **Animal House**, *and I wanted my college years to include that kind of crazy fun. But I also wanted an academically prestigious university. UVA was the perfect combination. Those who cherish political correctness may find some aspects of UVA a bit backward; there are few open gays, and football games are still coat-and-tie affairs."*

If You Had It to Do Over Again, Would You Go to UVA?

Most reviewers are passionate about the place. All but one would gladly go there again.

"Without question. It's hard to adequately convey the depth of feeling most students have for the school, a truly remarkable place. UVA presented me with a delicious array of choices, and I created the best four years of my life."

"Absolutely. UVA gave me a chance to learn a lot, to grow socially, and to create a strong foundation for my career. My friends at work admire my strong (well, fervent) school pride, which I share with almost all UVA alums."

"Yes. If you ask me, UVA's lively mix of academics and socializing is a good preparation for the real world. And the tuition at a 'public Ivy' is hard to beat."

"No. I loved my friends and the beautiful Grounds, but the weekend partying was too rowdy for me. Prospective students should visit before deciding whether to come here."

As you try to find the college or university best suited to you, the views presented above may be helpful. Keep in mind that these students might have had similar positive or negative experiences had they attended a different school. At any college, it is important to seek out challenging academic experiences and to create a social life that fits your personal style. ■

Note: The students quoted in the College Review Series are expressing their own views, which are not necessarily those of JHU or IAAY.

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THE COACH'S CORNER

by Chengde Feng

***Mr. Feng** teaches mathematics at the Oklahoma School of Science and Mathematics (OSSM) and has coached many students who have competed successfully in mathematics contests in China and the U.S. In this column, Mr. Feng offers Imagine readers questions designed to improve their problem-solving skills.*

PROBLEMS

1. For real number k, given that the system of linear equations $\begin{cases} x + ky = 10 & (1) \\ kx - y = 10k + 2 & (2) \end{cases}$ has exactly three integer solutions $x_1 = m_1$, $y_1 = n_1$; $x_2 = m_2$, $y_2 = n_2$; and $x_3 = m_3$, $y_3 = n_3$ with $m_1 < m_2 < m_3$, find the value of $m_1n_1 + m_3n_3 - m_2n_2$. (Hint: Find the value of k first.)

2. Find all three-digit numbers $\overline{abc}$, with $a \neq b$ and $a \neq 0$, such that the average value of all the numbers obtained by arranging $\overline{abc}$ in six different ways is $\overline{abc}$.

3. Given that a, b, c are three distinct numbers with $a + b + c = 0$, find the value of $\dfrac{a^2}{2a^2 + bc} + \dfrac{b^2}{2b^2 + ac} + \dfrac{c^2}{2c^2 + ab}$ (*).

SOLUTIONS

1. $(1) \times k - (2)$: $(k^2 + 1)y = -2 \Rightarrow y = \dfrac{-2}{k^2 + 1}$ (3)

$(1) + (2) \times k$: $(1 + k^2)x = 10 + 10k^2 + 2k \Rightarrow x = \dfrac{10 + 10k^2 + 2k}{1 + k^2}$

(3) $\Rightarrow$ y is an integer if and only if $k = -1$, 0, and 1

If $k = -1$, then $x = 3$, $y = -1$. If $k = 0$, then $x = 10$, $y = -2$. If $k = 1$, then $x = 11$, $y = -1$.

Therefore, $x_1 = m_1 = 9$, $y_1 = n_1 = -1$; $x_2 = m_2 = 10$, $y_2 = n_2 = -2$; $x_3 = m_3 = 11$, $y_3 = n_3 = -1$.

Thus $m_1n_1 + m_3n_3 - m_2n_2 = -9 - 11 + 20 = 0$.

2. $\dfrac{\overline{abc} + \overline{acb} + \overline{bac} + \overline{bca} + \overline{cab} + \overline{cba}}{6} = \overline{abc}$

$\Rightarrow \overline{abc} + \overline{acb} + \overline{bac} + \overline{bca} + \overline{cab} + \overline{cba} = 6\,\overline{abc}$

$\Rightarrow 100a + 10b + c + 100a + 10c + b + 100b + 10a + c + 100b + 10c + a + 100c + 10a + b + 100c + 10b + a = 6\,(100a + 10b + c)$

$\Rightarrow 222(a + b + c) = 600a + 60b + 6c$

$\Rightarrow 162b + 216c = 378a \Rightarrow 7a = 3b + 4c$ or $7(a - b) = 4(c - b)$

$\Rightarrow$ either $a - b = 4$ and $c - b = 7$ for $b = 0$, 1, and 2, or $a - b = -4$ and $c - b = -7$ for 7, 8, and 9

$\Rightarrow$ There are six such numbers altogether. They are 407, 518, 629, 370, 481, and 592.

3. $\dfrac{a^2}{2a^2 + bc} = \dfrac{a^2}{2a^2 + b(-a - b)} = \dfrac{a^2}{2a^2 - ab - b^2} = \dfrac{a^2}{(a - b)(2a + b)} = \dfrac{a^2}{(a - b)(a - c)}$

By symmetry, $\dfrac{b^2}{2b^2 + ac} = \dfrac{b^2}{(b - c)(b - a)}$ and $\dfrac{c^2}{2c^2 + ab} = \dfrac{c^2}{(c - a)(c - b)}$

$$\Rightarrow (*) = \frac{a^2}{(a - b)(a - c)} + \frac{b^2}{(b - c)(b - a)} + \frac{c^2}{(c - a)(c - b)} = -\frac{a^2(b - c) + b^2(c - a) + c^2(a - b)}{(a - b)(b - c)(c - a)}$$

$$= -\frac{a^2(b - c) + bc(b - c) - a(b^2 - c^2)}{(a - b)(b - c)(c - a)} = -\frac{a^2 + bc - a(b + c)}{(a - b)(c - a)} = -\frac{a(a - b) - c(a - b)}{(a - b)(c - a)} = 1.$$

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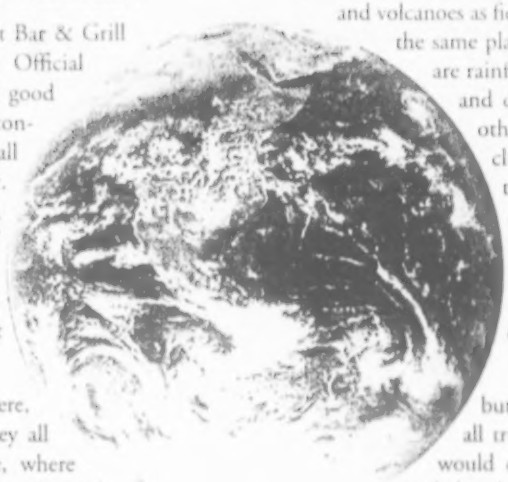
The Strangest Planet I Ever Heard Of

by Stacy Cowley

We get people from all corners of the universe in here, from little blue fuzzballs to rainbow-colored gaseous blobs and everything in between. The Boxly Roundabout is just around the corner from pretty much anywhere anyone would ever want to head to, and most everyone who heads through winds up at my place at some time or other.

I've been running Bill's All-Night Bar & Grill as long as anyone can remember. Official name aside, this bar is really just a good place to go for a decent meal and a conversation. Sounds nuts, but that's all most travelers really want. Intergalactic nature, I suppose. A man roams the width and breadth of the galaxy seeing the marvels of creation, and deep down inside all he's really looking for is something to eat and someone to talk to.



Like I said, we get all kinds in here, with all kinds of stories to tell. They all want to talk about who they are, where they've been, where they're heading, and mainly where they came from. Seems most galaxy wanderers get homesick sooner or later, and telling someone about their world is the next best thing to going back there.

I met one furry little critter who came from a planet that's nothing but a bunch of gases, and all the stuff on it just sorta floats around. There's another world I heard about where the ground is too hot to walk on, so everyone lives in the sky, like birds.

But by far the strangest planet I ever heard of is a little blue and white one tucked way out at the very edge of the Centauri sector. A tall tan-colored fellow who was in here about three years ago told me about it—swears he was born there. The strange thing about the planet is that it's almost like a whole little universe. It's got oceans as beautiful as those on Voomph and volcanoes as fiery as the ones on Nymth—both, on the same planet! The traveler claimed that there are rainforests like those in the Galen sector and deserts like the famous ones at the other end of the universe in the Rynak cluster. It has snow-capped mountains and canyons and huge cities and pyramids and exotic animals—a sampling of all the most spectacular sights in the universe and an infinite number of possibilities, all on *one planet*.

I've never heard of anything like it, but the man swore by Sinax that it was all true. I wondered aloud why the man would ever leave such a paradise. He just smiled and gave a vague answer about it taking him a long time to realize what was truly important.

The traveler wasn't sure exactly where the little blue-white planet was nowadays, but he gave me a rough set of coordinates before he left. I never saw him again, but I've often thought of him and his strange world. Who knows? Someday I may retire, take the coordinates he gave me, and wander around looking for that planet. It's probably just a fairy tale, but if not, well, we could all use a little time in paradise.

Stacy Cowley wrote this story when she was a sophomore in high school. She is now a sophomore at Barnard College, where she is majoring in Political Science/Political Economy. Stacy is still an active writer and plans to take a fiction class in the spring.

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MARK YOUR CALENDAR...

with these registration deadlines for selected academic competitions. Inquire about competition format, dates, and fees.

DEADLINE	COMPETITION
January	**National Mythology Exam**—Schools register students in grades 7–9: American Classical League, Miami University, Oxford, OH 45056; (513) 529-7741, fax (513) 529-7742.
Spring and Fall	**Ralph Waldo Emerson Prize**—Students submit history essays to *The Concord Review*; authors of published essays are eligible for one of three $3,000 prizes; grades 9–12: Dr. William Fitzhugh, The Concord Review, P.O. Box 661, Concord, MA 01742; (800) 331-5007; www.tcr.org
Mid-February	**National Federation of Press Women High School Journalism Contest**—Individuals submit entries through state affiliates, grades 9–12; *some state deadlines may be earlier:* NFPW Headquarters Office, 4510 West 89th Street, Suite 110, Prairie Village, KS 66207; (800) 780-2715, fax (913) 341-6912; 71072.2356@compuserve.com
April 2	**Knowledge Master Open**—Schools enter one team each for middle, junior high, and high school divisions: Academic Hallmarks, Box 998, Durango, CO 81302; (800) 321-9218 or (970) 247-8738, fax (970) 247-0997.
April 8	**USA Computing Olympiad Competition Round**—Grades 9–12: Dr. Donald T. Piele, University of Wisconsin-Parkside, Kenosha, WI 53141; (414) 634-0868, piele@cs.uwp.edu; usaco.uwp.edu
May 1	**American Regions Math League (ARML)**—Teams register for national competitions held at Penn State and Universities of Iowa and Las Vegas; grades 7–12: Mark Saul, ARML President, 711 Amsterdam Avenue, New York, NY 10025; (212) 666-5188.
June	**USA Mathematical Talent Search (USAMTS)**—Individuals enter for 1998–99 school year (collaboration between the Consortium for Mathematics and Its Applications and the National Security Agency): Annette Moccia, COMAP, Inc., Suite 210, 57 Bedford Street, Lexington, MA 02173; (800) 772-6627 x29.

STATEMENT OF OWNERSHIP, MANAGEMENT, AND CIRCULATION, 10/1/97

Title: *Imagine*. Pub. No. 1071-605X. Frequency: Sept./Oct., Nov./Dec., Jan./Feb., March/April, May/June. Five issues published annually. Subscription price: $30.00. Location of office of publication: The Johns Hopkins University Press, 2715 North Charles Street, Baltimore, MD 21218. Headquarters of publishers: The Johns Hopkins University Press, 2715 North Charles Street, Baltimore, MD 21218. Publisher: The Johns Hopkins University Press, 2715 North Charles Street, Baltimore, MD 21218. Editor: Melissa Hartman, IAAY, The Johns Hopkins University, Baltimore, MD 21218-4319. Owner: The Johns Hopkins University, Baltimore, MD 21218. The purpose, function, and non-profit status of this organization and the exempt status for Federal income tax purposes have not changed during the preceding 12 months.

Extent and nature of circulation	Av. no. copies each issue preceding 12 mos.	Actual no. copies single issue pub. nearest to filing date
A. Total no. copies printed	7911	8144
B. Paid circulation, mail subscriptions	4826	5044
C. Total paid circulation	6421	6654
E. Free distribution	785	785
G. Total distribution	7206	7439
H. Copies not distributed	705	705
I. Total	7911	8144

I certify that the statements made by me above are correct and complete.
Marie R. Hansen, Associate Director

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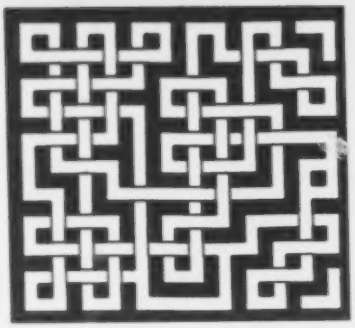


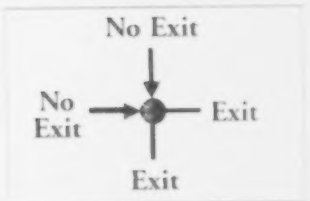
Knossos Games

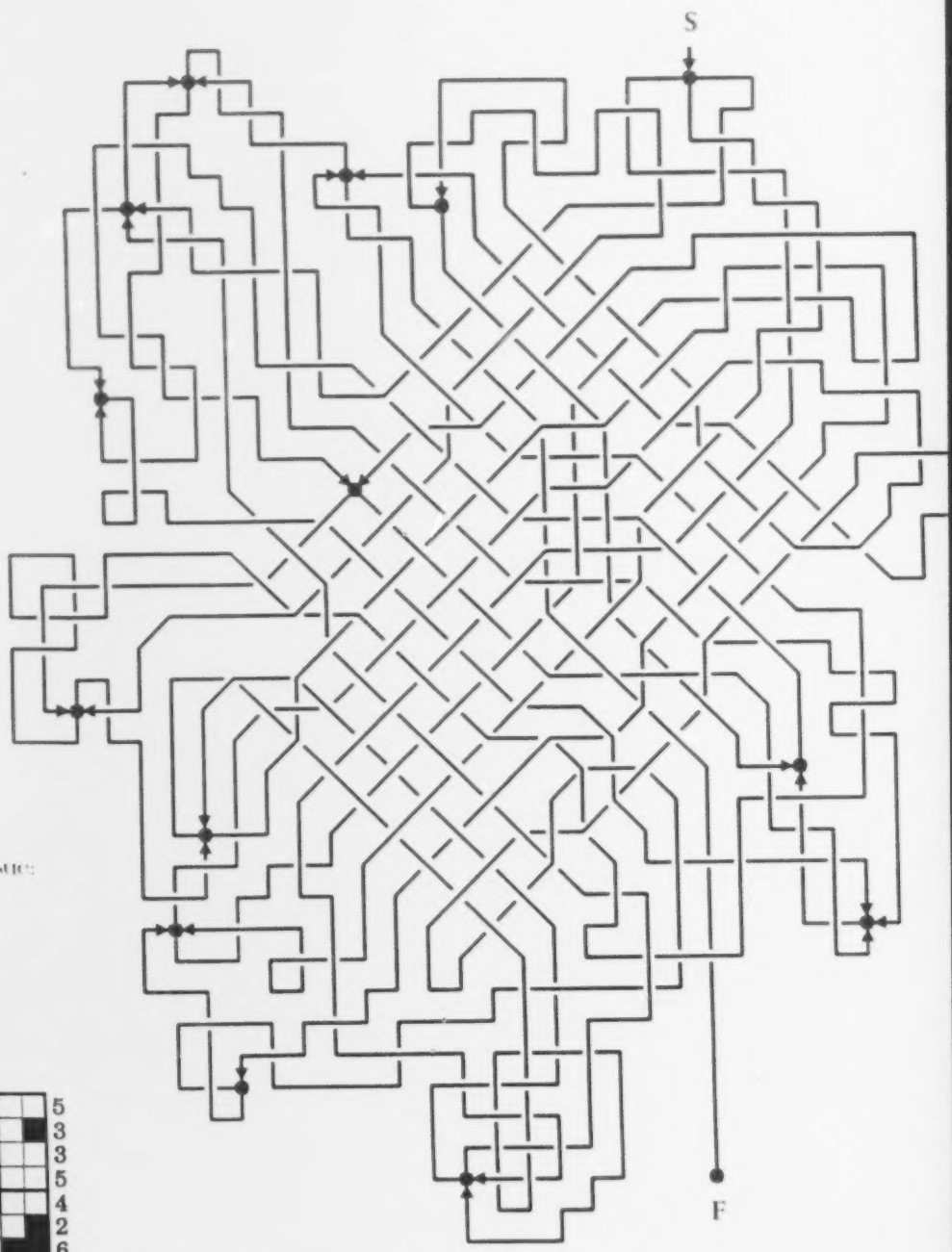
by Tim Boester

A fourth-year mathematics student at the University of Chicago, Tim Boester is fascinated by puzzles and mazes. He is currently applying to graduate school, where he plans to continue his mathematical pursuits.

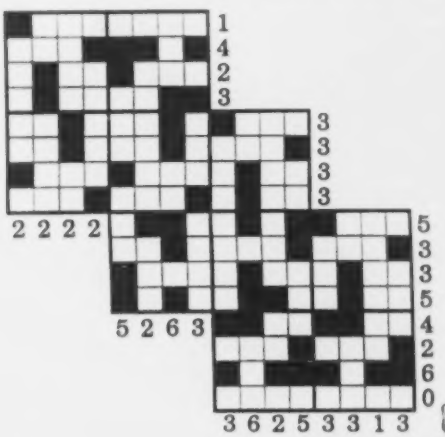
The Goal:
Go from Start to Finish passing through as few nodes (circles) as possible.

The Rules:
You may enter a node by any path, but you cannot exit a node against the arrows (see example).





Solution to Knossos Games in our November/December issue:



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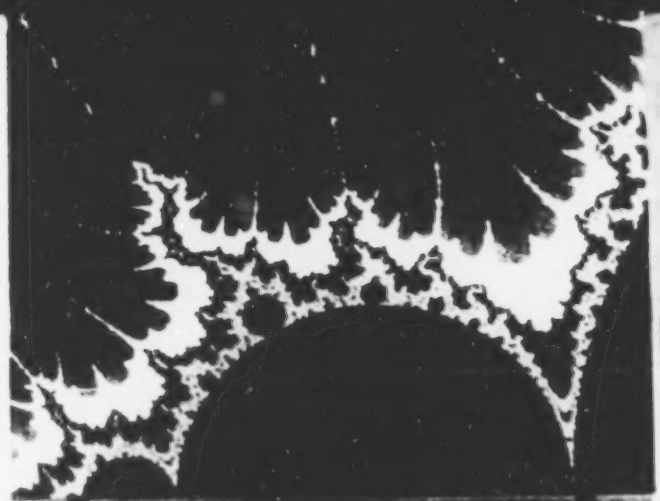
VOLUME 5 • NUMBER 4

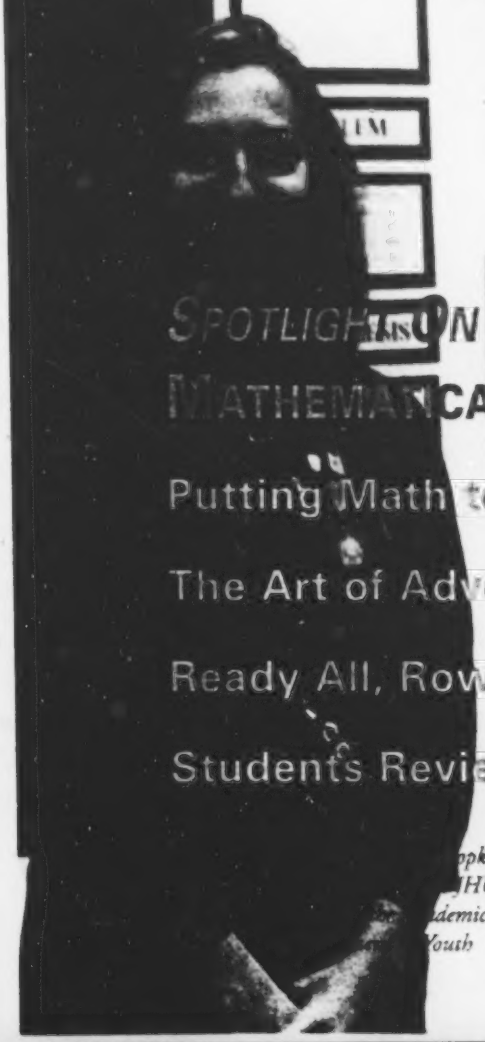
Imagine

Opportunities and Resources for Academically Talented Youth

March/April 1998



A STUDY OF THE MANDELBROT SET AND THE BIFURCATION DIAGRAM



SPOTLIGHT ON MATHEMATICAL PURSUITS

Putting Math to Work

The Art of Advertising

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From the Editor

Dear Reader,

When was your last encounter with mathematics? Perhaps it was in the classroom, or at home as you prepared for a test or competition. Maybe you found yourself using math to figure out how much money you'd save on a CD discounted 15%, or how long it would take you to travel from home to a friend's house. Or you might have enjoyed a video game, completed an assignment using a computer application, or programmed your VCR. If you were to make a list of your daily activities, you would probably find it difficult not to include activities that require or are enabled by mathematics.

But even these useful everyday applications of mathematics, numerous as they are, give only a hint of what the field of mathematics actually encompasses. If we're observant, we can see math all around us, whether it's in the spiral of a sunflower's seeds, the geometry of architecture, or the fractal design of a coastline. The structure of cauliflower, changes in traffic patterns, and the motion of planets can all be described mathematically. Even music and sculpture can be analyzed with mathematical tools.

Because math can help us understand and explain such diverse phenomena, it has an incredible range of applications. Mathematics has a particularly strong link to the sciences, as innovations in one area often lead to advances in another. Knot theory, for example, which was investigated as part of pure mathematics in the nineteenth century, was found in 1985 to have applications to quantum theory and later to the study of how DNA unknots itself. Similarly, chaos theory, now widely considered to be a mathematical area, has roots in meteorology and ecology. As more applications of math are discovered, the number of opportunities for people with mathematical backgrounds increases.

In this issue of *Imagine*, we explore some of the exciting ways you can put your mathematical interests into practice. One of our writers, a veteran of numerous math competitions, explains how extracurricular math activities can help you grow as a student and a person. Another high school student and a graduate student introduce you to the mathematical topics—number theory and moduli spaces—that have challenged and fascinated them. And several of our contributors—financial analysts, an economist, a software engineer, and a writer—describe how they are putting math to work in diverse ways.

We hope that this issue of *Imagine* will help you to appreciate some of the ways you can benefit from studying math. By encouraging clear and logical thought, refining problem-solving skills, and challenging the imagination, mathematics can prepare you to succeed in many fields. And with its focus on patterns and order, math can illuminate beauty in the world that you might not have noticed. After seeing through the eyes of our writers, look around. You just might see the world—and math—in a whole new way.

Melissa Hartman

Correction

The photograph of Greg Chirikjian that appeared on page 18 of the last issue should have been credited to John Goell. We apologize for this omission.

Imagine...
*Opportunities and Resources for Academically Talented Youth**

ISSN 1071-605X
Volume 5 • Number 4
March/April 1998

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Published five times a year—September/October, November/December, January/February, March/April, and May/June.

Application to mail at Periodicals Postage Rates is approved at Baltimore, MD, and additional mailing offices.

POSTMASTER: Send address changes to *Imagine*, The Johns Hopkins University Press, Journals Publishing Division, P.O. Box 19966, Baltimore, MD 21211.

Imagine is published by the Johns Hopkins University Press for the Study of Exceptional Talent (SET) at the Johns Hopkins Institute for the Academic Advancement of Youth (IAAY). This publication is an outgrowth of newsletters and programs that, for twenty-five years, have served highly talented students identified by the Study of Mathematically Precocious Youth (SMPY) and by SET.

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Editorial Assistant • Mary Parker
Designer, JHU Press • Roberta R. Proctor

Annual subscription: $30.00

Address subscription inquiries to:
Journals Publishing Division
The Johns Hopkins University Press
2715 North Charles Street
Baltimore, Maryland 21218-4363
(410) 516-6989 • fax: (410) 516-6968
toll-free: (800) 548-1784

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On the cover: Megan LePere-Schloop, of Detroit, MI, presents her research on the Mandelbrot set at the 1996 International Science and Engineering Fair. Photo courtesy of Science Service.

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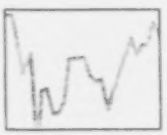
CONTENTS

Focus On: Mathematical Pursuits

The Unity of Mathematics
Where can the study of arithmetic and geometry lead you? As Ashley Reiter explains, these basics are your link to some of the most current and interesting areas of mathematics 4

Bringing Math to the Market

A former math professor, Glen Whitney has found new intellectual challenges in the financial market . 5

Mathematical Modeling in the World of Finance
Quantitative analysts, a new breed of money managers, are using mathematical models to identify and profit from trends on Wall Street 6

Power Tools: Synthesizing Math and Computer Science
Benjamin Weiss's cutting-edge software designs employ mathematical trickery. But they are so user-friendly that they are changing the industry 7

Economics: Applying Math to Real-World Problems
What determines the price you pay for a baseball ticket? Should the U.S. impose tariffs? A background in mathematics helps economists answer such questions 8

Beyond the Chalkboard: The Job of a Math Professor
John Quintanilla explains why a math professor's work is never done—and *why he wears knickers to class* . . 10

Number Theory: A Glimpse into the Beauty of Mathematics
Christopher Mihelich introduces some of the creative challenges offered by number theory, one of the most interdisciplinary and artistic branches of mathematics 11

Exploring Moduli Spaces
By drawing "maps" of numbers and other mathematical sets, students can see a whole new area of math take shape 12

Math Outside the Classroom
A childhood interest in math games led Wei Ho to mathematics competitions, summer programs, and an Olympiad 14

Mathematics Competitions, Summer Programs, and Resources

How to keep developing your skills and strengthening your passion for math 16

Putting Math into Words
Ivars Peterson, math and physics writer for Science News *and author of several books, talks about going from equations to sentences and back again* 18

Parting the Waters: The Rigors and Rewards of Crew

During crew season, an exhausted Eric Clopper gets home late and still has all his homework to do. So why is he so happy? 20

Exploring Career Options: Advertising
Interview with CEO and Creative Director Lori Campbell 22

Fascinating Classics

Virginia Woolf's poetic masterpiece To the Lighthouse 24

Students Review Williams College 26

Planning Ahead for College
There's more to college than getting in, so choose your high school courses carefully 28

Math Challenge: Problems from the 1998 AHSME 29

Creative Minds Imagine
Photographs by Marshall Johnson, Landis Kauffman, and Mike Shattuck 31

Knossos Games 32

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The Unity of Mathematics

by Ashley Reiter

If linguists study languages, and chemists study chemicals, what do mathematicians study? Children might identify numbers as belonging to the realm of mathematics. Students of algebra might observe that mathematicians study equations and solutions to equations. More advanced students might expand this view, identifying sets and functions as major objects of mathematical study. As students continue to study mathematics, they may encounter an even greater number of mathematical objects—groups, rings, fields, vector spaces, operators, metric spaces, manifolds, and so on. But what do all of these objects have in common?

As a math major in college, I became acquainted with a wide array of mathematical objects much in the manner of a child visiting a zoo—intrigued by each species in succession, but rarely stopping to consider what features distinguish amphibians from reptiles, or what characteristics all mammals share. But in graduate school, as my mathematical vision widened and deepened, I began to appreciate the unity in the menagerie of mathematical structures.

Learning by Abstracting

One of the most important unifying ideas of mathematics is abstraction. You use abstraction when you first understand 5 as a concept, independent of any particular five objects, such as five fingers or five apples. You then have the ability to abstract further, to perform arithmetic operations, such as 5+5, without referring to a particular set of five things. Furthermore, once you learn that 5+5=10, you never need to repeat the process of counting the fingers on each of your hands to see that the total number of fingers is 10. Your discovery—that 5+5=10—is independent of all objects and can apply to all objects.

As you progress through elementary and high school mathematics, you continuously abstract from what you've learned earlier to understand new mathematical structures. In algebra, for example, you need not test all possible values for x to determine a solution to the equation x+5=10; rather, you can solve the equation by using your knowledge about the properties of addition that hold for all real numbers. Next, you can learn to solve all equations of the form x+5=? by considering a new mathematical structure, the function f(x)=x+5. At each step, the new structure you encounter is not an entirely new idea but a generalization of those studied earlier.

Abstracting makes the original mathematical concepts easier to understand by showing how both old and new pieces fit together into one big picture. For example, when you learn to solve both linear and quadratic equations, you might notice differences between them: a linear equation has at most one solution, while a quadratic equation has two. But as you generalize from linear (first-degree) and quadratic (second-degree) functions to study solutions of higher-degree polynomial equations, you see that the degree of the polynomial reveals the number of solutions. That quadratic equations have exactly two solutions is just a specific case of this more general truth.

Expanding Circles of Mathematical Study

In one way or another, nearly every branch of mathematics is a generalization of either arithmetic, the study of numbers and their interactions, or geometry, the study of shape. In fact, students may be surprised to see where generalizations of the math they're learning now can lead them.

Polynomial functions are an important abstraction of arithmetic. After learning to find solutions to these functions in high school, calculus students delve deeper, detecting maxima and minima of polynomials and other functions, and noticing the ways in which the functions increase and decrease. Students can use polynomials to approximate many different functions, from the exponential growth of a bacteria culture to the periodic behavior of the ocean tides.

Further abstraction of these same algebraic pursuits can lead to other fascinating areas, such as the study of fractals. When students study linear algebra in college, they generalize from the linear equations they learned about in high school, which have a straight line for a graph, to functions in many dimensions, whose graphs are flat lines, planes, or spaces. In linear algebra, students learn how to classify objects as one-dimensional, two-dimensional, and so on. If students generalize these ideas to sets with fractional dimension, they'll find themselves studying fractals.

College math students might also use their understanding of linear equations in many dimensions to study other functions in several dimensions. Solutions to these functions look quite exotic, like a whole sphere or the surface of a doughnut, and are studied by topologists and algebraic geometers. Again, by progressively generalizing from the knowledge gained in high school mathematics courses, students can eventually end up in some of the most interesting and current areas of mathematical inquiry.

It's tempting to perceive different areas of mathematics as separate from one another, especially when they're taught in different courses. But by studying the history of mathematics, students can start to see relationships between these different areas. Just as modern mathematicians build on the discoveries of those who came before them, students can understand mathematical ideas in an order that prepares them for more advanced study and, perhaps, to make further discoveries of their own. π

*While on hiatus from graduate school in math, **Ashley Reiter** is teaching at the Maine School of Science and Mathematics. She is looking forward to spending the summer traveling, reading, and thinking more about mathematics.*

For Further Reading

Newman, James R., *The World of Mathematics*. New York: Simon and Schuster, 1956.

Steen, Lynn Arthur, ed. *On the Shoulders of Giants: New Approaches to Numeracy*. Washington, D.C.: National Academy Press, 1990.

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Bringing Math to the Market

by Glen Whitney

Investing and money management have changed dramatically in the past three decades. Thirty years ago, one might put money in the bank, buy U.S. government bonds, or invest in corporate stocks. While deciding how to invest might have been difficult then, today's investor faces a host of additional possibilities—stock options, corporate bonds of all sorts (including the notorious "junk bonds"), mortgage-backed securities, and more exotic investments called "financial derivatives."

At the same time, the accessibility of financial markets has increased, and with large exchanges open worldwide, investors can trade 24 hours a day, six days a week. And as more people have moved beyond bank accounts to seek better rates of return, the volume of trading on each exchange has skyrocketed. For example, around lunchtime on one recent day, I noticed that IBM had traded more than 15,000 times since the New York Stock Exchange opened three hours earlier. That's more than one-and-a-half transactions per second—for just a single stock.

Spotting Trends

All of these changes mean that the amount of raw data available to the investor is exploding. This flood of data presents a potentially great opportunity. If you can analyze the data faster than everyone else and distill useful information from it, you have a significant competitive edge in the marketplace. You should be able to use the information you've gained to buy particular stocks, and then profit as others who react more slowly buy those same stocks and drive up their prices.

But the process isn't always quite that simple. A great deal of randomness goes into the workings of financial markets—the exact moments that individual investors around the world choose to buy or sell, for example, or the unexpected announcements about profits or earnings that dozens of companies make every day. Filtering out that randomness to discern underlying trends poses a significant mathematical challenge.

Using the knowledge you've gleaned to choose what and when to buy presents another mathematical problem. Trading to change your investment holdings carries an inherent cost, a result of how markets work: In order to buy, you have to pay enough to convince someone else to sell; in order to sell, you have to be willing to accept a price low enough for others to buy. So if the price of your investment didn't change, you'd always sell for a bit less than you bought and lose money. In essence, you pay that difference—called the "spread"—every time you substitute one investment for another in your portfolio. In addition, you pay commissions to brokers for the service of finding someone who wants to buy whatever you're selling. If you make too many transactions, all your profits are eaten up by these costs; but if you don't trade enough, you miss the profit opportunities you've worked so hard to detect. Good mathematical models of trading help you walk the fine line between these extremes.

Becoming a Renaissance Man

It's no surprise that mathematical finance is heating up as a specialty in business schools, in universities' math and economics departments, and on Wall Street itself. Someone like me, a former assistant math professor with a master's degree in linguistics and a doctorate in logic, might seem an unlikely candidate for becoming a "quantitative analyst," as math-based money managers are commonly called. But if you walk down the hall at my firm, Renaissance Technologies, you will pass the offices of an astronomer, a computer scientist, three physicists, a computational linguist, and an operations researcher—so there's no rule as to what type of mathematical background is necessary to get involved.

I was drawn to the field serendipitously. Several years ago, I did summer research with a group working on trying to get computers to turn audible speech into typed words. Some members of that group now work at Renaissance, and the idea that similar technology could be applied to investing and to speech recognition intrigued me. I was also attracted by the opportunity to turn ideas into reality very quickly. If the computer simulations I'm running this weekend look profitable on Monday, the ideas behind them could affect the way we trade on Wednesday.

Back to the Future

Although I'm not using the specific collection of facts from logic that I accumulated while a graduate student and assistant professor, many of the skills I gained then serve me well now. One important example is the ability to pick up new mathematical ideas quickly—I'm learning a great deal about statistics, mathematical modeling, time series analysis, and modern regression techniques. But perhaps most critical is the ability to think creatively about new mathematical relationships.

One constant of the financial world is that individual investment strategies become less effective over time. For example, it used to be the case that bond prices would go down just before the U.S. government auctioned off a new batch of treasury bonds and then go back up afterwards. But as more and more people tried to buy bonds before the auction and sell them afterwards to profit from this pattern, bond prices were gradually driven up before the auction and driven down afterwards, until the effect disappeared altogether. Therefore, to be successful, a company like ours must always seek new, more subtle relationships among the world's investments. I'm confident that however much I learn about the way markets work, there will always be fresh intellectual challenges for me in mathematical finance. π

*When he's not developing trading strategies for the equity research group at Renaissance Technologies, **Glen Whitney** divides his time between his wife, his daughter, and on speculating about what his third career after math professor and quantitative analyst will be.*

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Mathematical Modeling in the World of Finance

Proprietary Trading

by Eric Wepsic

I work in proprietary trading for a technologically sophisticated investment bank called D. E. Shaw & Co. My group buys and sells financial securities (like stocks, bonds, futures, and options) using complex statistical models developed by the firm. This trading is called "proprietary" because we do it for the firm's own account rather than for customers and because the algorithms and methodologies we use are secret.

At D. E. Shaw, orders to buy or sell securities are virtually always suggested by automated systems. The models that generate these trading suggestions were developed, and are continually refined, using advanced mathematical and statistical methods. While financial intuition is sometimes useful, our focus is definitely on quantitative analysis. Very few firms engage in this type of proprietary trading because it's complicated and doesn't rely on the subjective judgments of human traders.

My job is to make our trading more profitable. I write programs that decide which securities should be bought and sold to make money while minimizing risk. I also work to improve our tactics for implementing decisions to buy and sell, monitoring the results of our trading to confirm that what actually happens matches our models. My mathematical background gives me the judgment necessary to simplify complex financial and programming situations and not to be led astray by mathematical or statistical fallacies.

I like the fact that my job has a direct impact on the success of the company—we do millions of dollars' worth of trading every day using the quantitative models that I work on.

On an intellectual level, my work excites me more for its clarity than for its depth. That is, I find my mathematical background most useful not for specific subject matter, but rather for the discipline of thought it gives me—the ability to recognize a situation for what it is, and the persistence to solve complex problems.

I recently interviewed a college senior who asked me how my work compares to the thrill of solving a problem set. I told him that in my work there are no problem sets, only blank sheets of paper. No one identifies the problems, much less the tools we should use to solve them. At D. E. Shaw, we have to make up our own methods for improving what we do. I love the creativity and insight this requires. I also love the satisfaction I derive by solving these problems effectively and completely. π

Eric Wepsic completed an M.A. in mathematics at Harvard before starting work at D. E. Shaw, where he has been promoted to the rank of senior vice president.

Derivatives Trading

by Sendhil Revuluri

I've always been interested in the workings of the markets, but I didn't consider a career in finance until my senior year in college. After completing majors in physics and math, and working several summer jobs in preparation for graduate study, I became discouraged by the bleak outlook for employment in physics. So when the time came to apply to graduate school, I also interviewed for entry-level jobs in finance. I ultimately decided against graduate school, accepting a position at Swiss Bank. Four years later, I'm still here.

Today I work mainly on the pricing and risk management of derivatives—securities whose value depends on, or derives from, the prices of stocks, commodities, or bonds. Just as the temperature of one side of a refrigerator door depends on the temperature of the other side, the value of a derivative security may change with increases or decreases in stock prices or currency exchange rates.

Trying to understand and react to constant changes in the market is demanding—I encounter new analytical problems every day. My math background often allows me to see connections where others don't and to apply existing techniques to new areas. I use many kinds of math, from differential equations, which allow me to calculate the values of derivative securities using information about price movements, to mathematical statistics, which help me to model the movements of prices. Mathematical simulations help me understand new kinds of derivatives, and computational methods help me put these insights into practice and turn algorithms into computer models that help our company manage risk.

Although the problems you face in this field may sometimes seem more difficult than interesting, a good business environment will provide you with responsibility, the chance to build something new, and frequent opportunities to learn new things. If you do a good job, the material rewards are substantial. These have all been very positive aspects of my work at Swiss Bank.

If you think you would enjoy working in a business environment, consider the world of finance. It's a great place to apply your mathematical talents to new challenges every day. π

Sendhil Revuluri graduated from the University of Chicago at the age of 18 and has worked at Swiss Bank Corporation since 1994. He enjoys traveling, reading, playing ultimate frisbee, and cooking vegetarian foods.

Hedge Fund Management

by Chris Welty

After I earned my degree in mathematics, I chose a job in trading because it seemed like more fun than a more traditional job in math or computers. I haven't been disappointed. Every day is like a math contest: you give it everything you've got, and at the end of the day you know your results. There's no waiting around for months or years to measure

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your performance: either you've made money or you've lost it.

In a "relative-value" or "arbitrage" hedge fund, such as the one I am starting, the goal is to use models to find mathematical or statistical relationships between different securities—currencies, stocks, or bonds. Models can be quite simple, as in "pairs trading." This model assumes that similar stocks are influenced by the same factors, so if GM stock were to become more valuable, I would buy Ford stock. Other models rely more heavily on math, predicting stock options on the basis of stock prices, or bond prices on the basis of short-term interest rates.

Applying models usually involves solving differential equations by computer. However, you can't make money just by looking at the results on a printout—you have to understand the model. Models are generalizations; they don't take into account every conceivable factor. You have to know what assumptions a model makes and how to make adjustments for specific situations. You also have to be able to create entirely new models. In fact, success in this field comes from finding new things to model, creating new models, and buying and selling based on those models.

While I enjoy the frenzied intensity of buying and selling, it is the mathematics of relative-value trading that keeps me interested. It's like physics in that you solve equations to figure out what's going to happen. It's unlike physics in that you're not sure what equations you should solve, or whether those equations stay the same over time, or even whether there *are* equations—you just have to create equations that describe the past relatively well and see if they predict the future. It's like the early days in any science, when not much is known and the basic principles are being discovered, because you don't need years of study to get to the cutting edge of research; six months after getting out of college you can be extending the frontiers of knowledge. π

Chris Welty graduated from Berkeley as valedictorian in mathematics when he was 19. Previously head of bond arbitrage at SBC Warburg Dillon Read, he is currently starting up his own hedge fund management company in London.

Power Tools: Synthesizing Math and Computer Science

by Benjamin Weiss

When I was four years old, my father came back from a fishing trip with a four-foot, 48-pound albacore. I observed that this came out to 12 pounds per foot, which seemed like a perfectly natural thing for me to say, though it understandably raised his eyebrows a bit. Twenty years and a bachelor's degree in applied mathematics later, I find myself using the mature versions of that same mathematical curiosity to raise the eyebrows of a much wider audience.

I probably would have pursued a Ph.D. in mathematics had I not stumbled onto an amazing opportunity after my sophomore year in college. My father, out surfing one day, met a fellow surfer who worked for a small computer company called HSC Software. After a complicated series of events, I was invited in for an interview. The company wasn't in the software business at the time, and the people who interviewed me weren't sure quite what to do with me, but their reaction was unanimous: "You should talk to Kai."

Kai Krause, a visionary in the software industry since the early 80s, had joined the company only a few months earlier. The two of us discovered that we had a great deal in common, and as we worked together we became good friends. Over the summer we designed and wrote a set of graphics special-effects tools called Kai's Power Tools, which challenged me to integrate elements of mathematics and computer science into a consistent whole. The product's unprecedented success changed the focus and direction of the company overnight. Now called MetaCreations Corp., the company has grown from 12 employees to more than 300, a breathtaking elevator ride.

Our company's success derives in part from our effort to synthesize the disciplines of mathematics and computer science. Mathematicians today have access to monstrously powerful computers on which to execute their calculations. With so much computing power at their fingertips, they take for granted the power of the underlying hardware and give little thought to how to implement their particular task most efficiently. Thus, hardly any complex mathematical software (weather simulation programs, for example) can run on a home computer because the hardware simply isn't fast enough!

Or is it? Home computers these days are easily a hundred times faster than they were just a decade ago. Millions of operations per second is faster than most people can conceptualize. Why must weather prediction require billions of operations per second, rather than mere millions?

A cornerstone of my working philosophy has been to break this cycle. By combining my expertise in the fields of mathematics and computer science, I strive to perform the impossible on run-of-the-mill machines. Much of our software, such as *Kai's Power Goo*, has yet to be imitated in the consumer software market because it pushes this synthesis to the extreme, taking advantage of every mathematical trick to squeeze the last ounce of power from the computer circuitry.

In designing this type of software, I first work out the mathematical core on paper, then break it down into its simplest logical steps. Then I wrap the core in several layers of algorithmic abstraction and simplification, and hook it up to a carefully designed graphical interface. This process allows me to shield the user from the technical details of the mathematical core, which makes the technology far more accessible to the masses.

By choosing to work in industry, I find myself in the perfect position to bring some of these new techniques to light. What might otherwise become an abstruse technical paper buried in an obscure mathematical journal now finds its way into millions of living rooms, burned onto CD-ROMs, nestled inside colorful boxes of usable software. This is the essence of applied science and technology. π

*A 1994 graduate of Harvey Mudd College, **Ben Weiss** has been tinkering with computer graphics since the early Apple II days. Currently an imaging scientist at MetaCreations Corp., he surfs the ocean by day and the Web by night, writing occasional bits of code in between.*

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NOMICS: APPLYING MATH AL-WORLD PROBLEMS

by Susan Athey

When I was in high school, thinking about my future, I had many plans. I thought I might be a psychiatrist, an entrepreneur, or maybe a computer scientist—but I never considered a career in economics. Sure, I read *The Washington Post* every morning, and I could repeat criticisms I had read of Ronald Reagan's "supply-side economics." But I couldn't have told you much about economics, other than that it had something to do with interest rates and recessions.

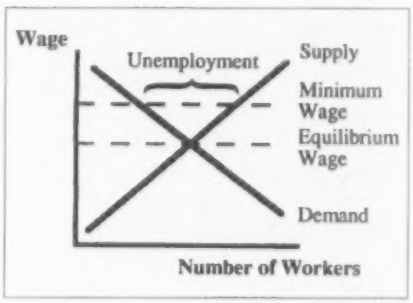
The Price of Televisions

When I entered college, I jumped right into computer science classes, taking an introductory economics course only because I thought I might someday work in a computer business. In that economics class, I learned the textbook definition of economics: the study of how "scarce resources"—land, energy, food, computers, or protection by military defense systems—get allocated to companies and consumers. One way these resources can be allocated is through markets that operate without too much day-to-day government interference. In such markets, firms are free to set their own prices, and consumers to choose what to buy.

So how do we figure out the price people will pay at the store for something like a television? The most basic model of a market needs two functions: supply and demand. We generally assume that demand decreases as price increases: the higher the price, the fewer people want TVs. Supply, on the other hand, increases as price increases: the higher the price, the more TVs companies are willing to sell. With these two functions, we can find the market equilibrium price, at which supply equals demand: the number of televisions companies are willing to sell at a given price equals [illegible] number of people who want televisions [illegible] hat price.

Applying the Models

In class, we learned how to use our models of markets to answer questions about government policy, such as what happens when the government raises the minimum wage. By requiring employers to pay wages higher than they otherwise would, the government could upset the market equilibrium: the supply of workers might become greater than the demand for workers.



Of course, to know how many people would lose their jobs, we would need to know the actual numbers for the supply and demand functions. Some economists spend a lot of time trying to figure out exactly what real-world supply and demand curves look like. But since economists don't usually make use of highly controlled laboratories as biologists and chemists do, they have to use a lot of ingenuity and statistical analysis to draw conclusions from the data they gather.

Partly for this reason, economists don't always agree with each other, as in the debate about raising the minimum wage. Some economists' research about supply and demand suggests that a lot of people would lose their jobs if the minimum wage were raised. Other economists have analyzed specific examples in the past in which the minimum wage did go up but the number of jobs stayed about the same. This second group of economists won the most recent debate in Washington: they convinced the president to increase the minimum wage, and Congress voted the increase into law.

The minimum wage question demonstrates the two main kinds of problems economists solve: empirical problems and theoretical problems. Empiricists spend most of their time working with data; they look for exact numbers that best match up with reality, like the economists who try to figure out the effect of raising the minimum wage. Theorists, on the other hand, write abstract mathematical models that capture only the most important parts of a real problem. An elegant theoretical model helps you understand the main ideas, as in the example of market equilibrium.

Although I was excited about the idea of using math to solve theoretical economic problems, the supply-and-demand models we studied in the introductory course seemed too simple. For example, the models did not allow for the possibility that firms might be able to charge different prices to different people, as when the local baseball stadium gives student discounts or when airlines charge less for the same flight when a Saturday night stayover is included. By using more complicated pricing structures, companies seem to charge low prices to people who don't want to spend a lot of money, but at the same time charge high prices to people who are willing to pay more.

To Fink or Not to Fink?

I might have given up on economics and stuck with computer science had I not taken a seminar on game theory and industrial organization, in which I learned that economic models could be much more

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powerful than I had previously imagined. These models could explain companies' strategic behaviors by formally analyzing the "games" that companies play.

Our education about game theory began with the famous "Prisoner's Dilemma," in which two criminals are brought into separate rooms for interrogation. The criminals have two choices: "fink" and implicate the other criminal, or stay silent. If neither finks, both will go to jail for one year. If one prisoner finks and the other is silent, the one who finks goes free and the other goes to jail for fifteen years. If both fink, both go to jail for ten years.

In game theory, you analyze games like this using the principle of Nash equilibrium, which is a set of strategies, one for each player. For the set to be a Nash equilibrium, each player's strategy must be a "best response" to the strategies of the other players. That is, each player makes the following calculation: Suppose I knew for sure that my opponents were going to follow a certain strategy. Then, is my strategy the best choice I can make in response?

In the Prisoner's Dilemma, the Nash equilibrium is for both players to fink. Why? Suppose you thought your opponent was going to stay silent. If you fink on him, you go free, while if you stay silent, you go to jail for a year. So your best response to an opponent staying silent is to fink. Now suppose that you thought your opponent was going to fink. If you remain silent, you go to jail for fifteen years, but if you fink, your sentence is only ten years. So your best response to an opponent finking is to fink. Thus, the Nash equilibrium is for both players to fink.

Game Theory in Real Life

The Prisoner's Dilemma has useful economic applications, such as in a trade war. Introductory economics teaches you that the best outcome for two countries results from free trade, with no tariffs. When both the U.S. and Japan have tariffs, cars and computers cost consumers more in both countries, fewer goods are produced, and both countries are worse off than with free trade.

But whether or not the Japanese decide to use tariffs, the short-term best response of the U.S. might be to place tariffs on some goods. The government profits from the taxes collected on each imported good, and American companies capture a larger market share when foreign imports are taxed. On the other hand, all consumers pay higher prices, and some even get priced out of the market. But if the U.S. is an important customer for Japanese firms, the Japanese might lower their prices in order to avoid losing all of their U.S. customers. If the Japanese lower their prices enough, the U.S. might do better by using a tariff. The "dilemma" is that Japan will make the same calculation, leaving both countries in the fink-fink Nash equilibrium of high tariffs all around.

We also learned in that class how to apply the tools of game theory to a wide variety of complicated problems, such as why gas stations tend to locate in clusters instead of isolating themselves; why beer companies sell almost the same product under different labels, a premium brand and a generic; and why companies might make more money by bundling several products together (a current example is Microsoft's attempt to bundle *Internet Explorer* with its operating system Windows). For each of these problems, we could write down a mathematical model and actually prove our answers. I never looked at a supermarket the same way again.

When I returned to math classes, it was with a new respect for math. I was no longer just plodding through problem after problem—I was learning tools that I would need to do my own research.

Making a Career of Applying Math

When I decided that I wanted to become an economics professor, I arranged to spend a summer doing research with an economist to gain experience. I was surprised when, after I asked him what classes I should take, he advised me to major in math! He told me that most undergraduate econ classes weren't as mathematically sophisticated as those I would soon encounter in graduate economics programs, and that lots of math is required to get into the top schools. So when I returned to math classes, it was with a new respect for math. I was no longer just plodding through problem after problem—I was learning tools that I would need to do my own research.

In graduate school, I became interested in the mathematical tools used to solve theoretical models. Before I knew it, I was discovering new ways to analyze models. I'll never forget my excitement and disbelief when I proved my first theorem.

When my classmates and I finished our Ph.D.s, we went looking for jobs. Some went to work for the government, while others went into research positions on Wall Street and in management consulting firms. Still others went to work for consulting firms that specialize entirely in legal cases involving economics. And many of us were hired by universities as professors.

Economics professors aren't always in their offices or the classroom, though. Companies and government officials frequently seek the advice of economists. Some of my colleagues serve on commissions to analyze particular policy problems, such as social security. Others go to Washington, D.C., for a few years to serve in presidential administrations; they might serve, for example, in the cabinet or on the Council of Economic Advisors. When they return to the university, their lectures are filled with real-world examples, and they have new ideas for research topics.

Careers in academia can take many directions, as professors spend some years focusing mainly on research, others on teaching, and others on shaping public policy. But no matter how they spend their time, it's a great way to make a career of applying mathematics to real-world problems. π

Susan Athey is an assistant professor of economics at MIT, where she holds the Castle Krob Career Development Chair. She is also a faculty research fellow at the National Bureau of Economic Research. Her recent empirical research has involved analyzing the roles of information and uncertainty in strategic bidding behavior in real-world auctions for timber.

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Beyond the Chalkboard: The Job of a Math Professor

by John Quintanilla

One part of my job is deceptively simple to explain: I teach math to college students. I teach only two classes a semester for just six hours a week, and I have a flexible schedule with summers off. How cozy!

Some people think I've got the easiest job in the world. But there is, of course, much more to the story. The hours I spend actually lecturing are only the tip of the iceberg. Delivering lectures that make sense *and* maintain students' interest for a full hour takes considerable practice and effort. Meanwhile, I am constantly fine-tuning the curriculum, writing exams, and grading homework assignments—tasks that keep me working late on many nights. In recent months my most time-consuming project has been to write 80—and counting—letters of recommendation for former students.

My work with students outside the classroom includes one-on-one tutoring, guiding student research projects, advising students about possible majors and careers, and sometimes just lending an ear when someone's had a rough day. As a professor I am a public figure on campus, and my current and former students come to me for counsel on a wide range of issues, many of which are only tangentially related to mathematics. I hope that through my words and counsel I am contributing to my students' development as people as well as scholars.

In addition to lecturing, writing recommendations, and counseling, I also have to produce original research. At my university, the quality of my teaching and my research will be weighted equally when I am evaluated for tenure in five years. The relative importance of teaching and research, however, varies from school to school. In general, small liberal arts colleges tend to emphasize teaching, while major universities want their professors primarily to be researchers.

When I started graduate school, I was introduced to my current field of research: applying ideas from probability theory to study theoretical problems in materials science. I have found that my research evolves through four stages: months of frustration, several days of sheer ecstasy when I'm overflowing with ideas, weeks of double-checking that my ideas actually make sense, and finally months of writing up my results for publication in scientific journals. I purposely work on three or four research projects simultaneously, hoping that the cycle of each is slightly out of phase with the others. Though I work on my research all year, it gets my undivided attention during the summer when I'm not teaching.

> In my "Hunt for Red October" lecture, I talk about applying trigonometry to submarine detection, linguistics, and opera; in my "Voyager 2" lecture, I describe how conic sections are used in planetary exploration.

Of the many aspects of this job, teaching is for me the most satisfying. I have found that my students, most of whom will not become professional mathematicians, respond enthusiastically to my "fun lectures." These lectures illustrate how the mathematics we're studying can be applied to fields of science. In my "Hunt for Red October" lecture, for example, I talk about applying trigonometry to submarine detection, linguistics, and opera; in my "Voyager 2" lecture, I describe how conic sections are used in planetary exploration. For my favorite fun lecture I dress up in knickers, carry my golf clubs into class, and use calculus to analyze the trajectory of golf balls. These lectures are quite popular with my students, and I love to watch their eyes light up when they're excited about learning new things.

Does my job sound appealing to you? If so, heed these words of warning: To become a successful professor, you have to really, *really* want this career. I am not a math professor for its financial rewards; friends of mine in industry earn salaries that are triple what I make. I don't mind, and I'm not envious of them—I get to do what I love for a living, and I'm not starving. But this job isn't for everyone. There are innumerable distractions and frustrations along the way that will derail aspiring professors who are not entirely focused on the goal.

For example, I always thought that I would be assured a job after graduation. In 1987, the National Science Foundation projected a shortfall of 675,000 scientists and engineers over the coming two decades. I was a high school senior in 1987, so I assumed I would be able to write my own ticket after earning a doctorate.

Time would show that this NSF projection, now derisively labeled "The Myth," was amazingly inaccurate. There is currently an overproduction of Ph.D.s in mathematics, and the job market for aspiring math professors is tight. The unemployment rate for freshly-minted Ph.D.s in mathematics has hovered around 10% throughout the 1990s. A new Ph.D. can expect a nomadic life—bouncing all over the country from one postdoctoral appointment to another—before finally landing a tenure-track position.

Faced with such daunting employment prospects, I braced myself for an unstable life in pursuit of my dream of becoming a professor. Even so, I must admit that getting avalanched by more than a hundred rejection letters was extremely disheartening. In the end, though, I was blessed with a tenure-track position straight out of grad school.

Like many jobs, the job of a math professor is frustrating at times and can feel overwhelming. But when it does, I think about the excited, curious students at a recent fun lecture and remind myself: I love this job! π

John Quintanilla earned his bachelor's and master's degrees from Stanford and his Ph.D. from Princeton. He is a second-year math professor at the University of North Texas.

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Number Theory: A Glimpse into the Beauty of Mathematics

by Christopher Mihelich

Once dubbed the "queen of mathematics," number theory has fascinated mathematicians for centuries. Number theory has long been regarded by many mathematicians as the most captivating field of mathematical study—as well as the most esoteric. The great unsolved problems of number theory are far more famous than those of other mathematical disciplines, yet the field has virtually no practical application, and most college students can easily graduate without once encountering the topic. Just what is number theory, and why has it intrigued so many mathematicians?

The Art of Numbers

At the simplest level, number theory is the branch of mathematics that deals with the properties of integers and equations that can be solved using only integers. This focus on integer solutions makes number theory one of the oldest branches of mathematics—the ancients, after all, dealt with rational numbers only—and also explains why number theory lacks practical applications: applied problems tend to involve approximations, not exact integer cubes and their ilk.

Number theory is a revered field of mathematical study because it elevates mathematics to an art form. If "it is art to conceal art," as the Roman poet Ovid once asserted, then number theory is truly artistic, as the problems that demand the most ingenuity to solve can often be stated in very simple terms. The statement of Fermat's last theorem, that $a^n+b^n=c^n$ has no solution for any integer value of n greater than 2, or of Goldbach's conjecture, that any even integer greater than 2 is the sum of two prime numbers, can be easily understood by an educated layperson. Yet the former problem resisted solution for more than three centuries, and the latter resists still.

These deceptively elementary assertions—simple to state, yet nearly impossible to prove—help to explain why number theory has appealed to centuries of mathematicians. Number theorists often must draw upon diverse subfields of modern mathematics—such as complex analysis, algebraic geometry, and abstract algebra—to assemble a proof, making number theory the most interdisciplinary branch of mathematics.

Creative Solutions

The creativity demanded of a number theorist is apparent in the solution of even an elementary problem: Do there exist positive integers x and y for which the following equation is true?

$$x(x+1)(x+2)(x+3)=y^2$$

Since quartics are not particularly amenable to analysis, this equation will not yield to a mechanical, purely algebraic approach. A more subtle technique is required.

First, we rewrite the equation as:

$$(x(x+3))((x+1)(x+2))=y^2,$$

$$\text{or } (x^2+3x)(x^2+3x+2)=y^2.$$

Whether x is odd or even, both factors on the left are even, so we may write:

$$((x^2+3x)/2)((x^2+3x+2)/2)=z^2$$

where z=y/2 is an integer and both factors on the left are integers.

Finding a solution requires that we note an interesting feature of this last equation: the positive difference between the two left-hand factors is 1. This has two powerful implications. First, these two factors are relatively prime: any common divisor of the two numbers also divides their difference. Since their product is a square number and they share no common factor, both are squares themselves: $(x^2+3x)/2=a^2$ and $(x^2+3x+2)/2=b^2$ for some positive integers a,b. But that would mean that $b^2-a^2=1$, an equation not satisfied by any positive integers a,b. Our subtle approach has shown that $x(x+1)(x+2)(x+3)=y^2$ has no solution among integers, a result quite different from those obtained by the analysis of polynomial equations using real variables.

Making Connections

Greater ingenuity is required to treat the similar but more imposing equation:

$$x(x+1)(x+2)(x+3)(x+4)(x+5)(x+6)(x+7)= y^2.$$

In this case it is useful to invoke an apparently unrelated theorem, namely, that if a square a^2 is factored as a product of two distinct positive integers, then the positive difference between these two factors is not less than twice the square root of a. How is this relevant to the mammoth equation presented?

A connection becomes apparent if we rewrite the equation as $AB=y^2$, where $A=(x+1)(x+2)(x+4)(x+7)$ and $B=x(x+3)(x+5)(x+6)$. We know that $|A-B|$ cannot be less than $2y^{1/2}$, which is easily shown to be at least $2x^2$; yet $|A-B|=16x+56$, which increases much more slowly with x than does $2x^2$. Our "unrelated theorem" then says that $2x^2\leq 16x+56$, which is false for $x\geq 11$. This theorem has therefore proven that any solution of our original equation must satisfy $x<11$. Checking the remaining ten cases on a calculator completes the proof that there are no solutions to this equation as well.

These solutions were rather indirect—the problems could not be solved by simple application of a standard formula. This demand for subtle and intricate ingenuity is perhaps the best reason for students to explore number theory. As they solve number-theory problems, students will notice that their solutions incorporate not only the structure and techniques of difficult mathematical proofs, but also the beauty and cleverness characteristic of the field itself. π

*A junior at Park Tudor School in Indianapolis, **Christopher Mihelich** enjoys programming computers and performing and composing music. Chris won first place in the 1998 WSTS for his mathematics project concerning polynomial quotient rings. He plans to enter college next year, where he will major in pure mathematics.*

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Exploring Moduli Spaces

by Jordan Ellenberg

There's more to math than just numbers and equations. In fact, much of mathematics concerns space—not outer space, but mental representations of space and of spatial relationships.

While many people think of Descartes as the first person to describe points in a plane by means of a pair of coordinates, the idea of coordinatizing planar space was known to Hipparchus in 150 B.C. And by 1640, Pierre de Fermat had already developed the idea of expressing a curve in the plane as the solution set of an equation in x and y. René Descartes, however, was the first to *systematically* use the coordinate plane to turn problems of geometry into problems of algebra, and vice versa. Today, at the very center of modern research in number theory and geometry lies a much-generalized form of Descartes's idea—that of *moduli spaces.*

What is a Moduli Space?

You might think of a moduli space as a map or a picture of a certain set. A map of the United States is, loosely speaking, a moduli space for the set of states. If you had a list of the 50 states and their sizes and shapes, and another list detailing which states bordered on which other states, you might still have only a fuzzy idea of what the United States looks like and how it is put together. But with a map, you would perceive this information clearly.

In math, you typically work with sets of objects, such as numbers, points, or lines. But just as with the states, you can often have a clearer understanding of a set if you have a "map" of it. A moduli space for a mathematical set might be a plane, a line, a curve, a cylinder, a hockey-puck-shaped entity, or even a wild hyperamoeba in 26-dimensional space. More specifically, a moduli space for a set S is a geometric object X such that

1) the points of X are in one-to-one correspondence with the elements of S; and

2) elements of S that are close to each other correspond to points of X that are close to each other, and vice versa.

The Coordinate Plane

Just as a picture of the United States is a map of the set of the states, the plane is a map of the set of pairs of real numbers. If S is the set of ordered pairs (x,y) of real numbers, a moduli space for S would be a plane, which we'll call X.

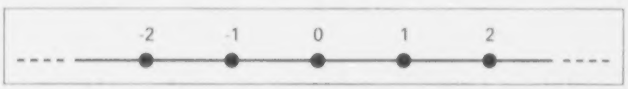
How does X satisfy our definition of moduli spaces? The one-to-one correspondence required by the first part of the definition sends an ordered pair (x,y) to the point (x,y) of the plane. The second part of the definition is satisfied because pairs of real numbers that are very close to each other, such as (1,2) and (1.001,1.999), map to points of X that are very close to each other; likewise, nearby points of X correspond to nearby pairs of real numbers.

So Descartes's insights about the coordinate plane can be summed up in the terminology of moduli spaces: A plane is a moduli space for the set of pairs of real numbers.

Challenge 1: What would be a moduli space for the set of *unordered* pairs of real numbers (x,y)?

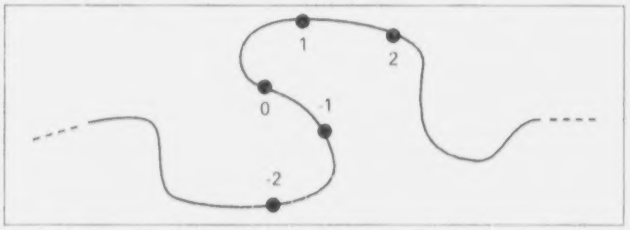
Distorting Space

You can probably guess that a line is a moduli space for the set of all real numbers.



A moduli space for the real numbers

But it is not the only one. We can distort the line in as devious a fashion as we like, taking care not to break it or let it cross itself (which would violate the second and first parts of our definition, respectively)—and the resulting curve will still be a moduli space for the real numbers.



Another moduli space for the real numbers

This example enables us to expand our definition of moduli spaces a bit: If X is a moduli space for a set S, any distortion of X is also a moduli space for S.

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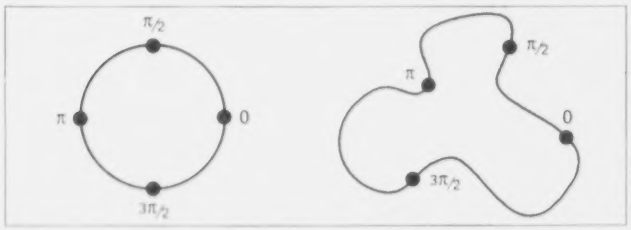
Circles, Cylinders, and More Moduli Spaces

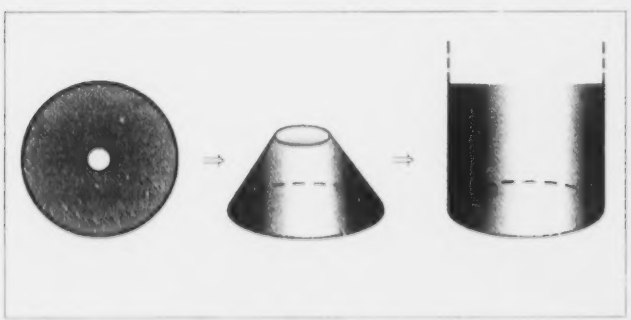
What if S is the set of all angles? We know that an angle is determined by its measure, which (in radians) is a real number between 0 and 2π. But the moduli space for S is not a line segment from 0 to 2π because those points, which are far away from one another in a line, correspond to angles that are identical to each other, violating our definition. To make a moduli space for S, we need to join the ends of the line segment to form a circle. Of course, a distorted circle will also do.



Two moduli spaces for the set of angles

Now let S be the set of ordered pairs (r,θ), where r is a positive real number and θ is an angle. If you know about polar coordinates, you know that the plane with the origin removed is a moduli space for S: (r,θ) corresponds to the point whose (x,y) coordinates are $(r\cos\theta, r\sin\theta)$. This moduli space is usually called "the punctured plane."

We can also think of the moduli space for this set in another way. We know that a circle is a moduli space for the set of angles. And we can see that a ray is a moduli space for the set of positive real numbers. So a moduli space for S can be constructed by starting with a circle and attaching a ray to each point. Of course, we don't have to plot r in the same plane as θ. If r is plotted perpendicular to the xy plane, the moduli space now looks like a cylinder, infinite in one direction. Note that this moduli space is just a distortion of the punctured plane.



From punctured plane to cone to cylinder

Challenge 2: What if S is the set of ordered pairs (r,θ), where r is *any* real number?

Challenge 3: What if S is the set of ordered pairs of angles (θ_1,θ_2)?

Playing Around with Correspondences

Suppose S is the set of all lines through the origin of the xy plane. What is a moduli space for S?

A line through the origin can be defined by the angle θ it makes with the x-axis. So we might guess that the moduli space for S is the same as the moduli space for angles: a circle. But as we consider the problem more carefully, we hit a snag. The natural correspondence between lines and angles is not one-to-one, but *two*-to-one: the angles $\pi/2$ and $3\pi/2$ both correspond to the vertical line. How can we address this problem?

One good way is to use a *different* correspondence between lines and angles: Instead of associating line L to the angle θ, we could associate it to the angle 2θ. That simple redefinition transforms our two-to-one correspondence to a one-to-one correspondence. Using this new correspondence, we can see that the moduli space for S is indeed a circle.

Challenge 4: What if S is the set of *all* lines in the xy plane?

What I like about problems like this one is that they don't require much, or any, pencil-and-paper calculation. You can work on them in the shower or while riding the bus. Better yet, the problem admits endless variations, each with its own interesting features: What is the moduli space of circles in a plane? Circles through the origin? Lines through the origin in three-dimensional space? The possibilities are limited only by your imagination (and, if you are working in the shower, by the hot water supply.) Enjoy! π

Jordan Ellenberg, a doctoral candidate in mathematics at Harvard, will be an instructor of mathematics at Princeton starting in fall 1998.

Answers to challenges:

Challenge 1: X is a half-plane: for example, the half-plane defined by $\{(x,y): x \geq y\}$

Challenge 2: X is an infinite cylinder.

Challenge 3: X is shaped like the surface of a doughnut—a surface mathematicians call a "torus."

Challenge 4: X is the famous Möbius strip.

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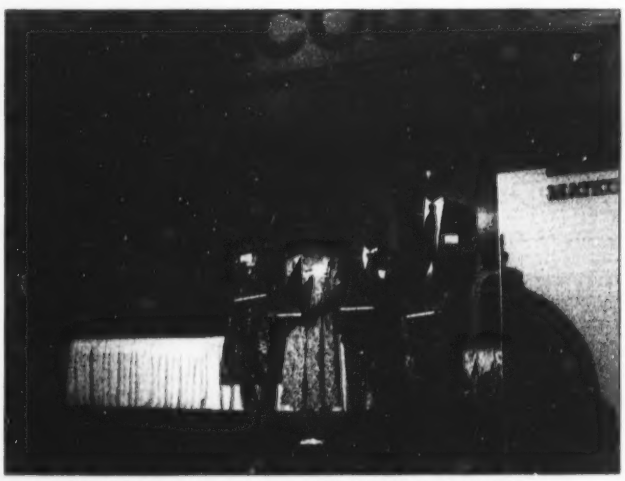
Math Outside the Classroom

by Wei Ho

At what temperature are Celsius and Fahrenheit readings the same number? It is almost obvious to me now that the answer is -40°. When I was six years old, however, the question was not so simple and required a great deal of thought. It was one of the many "math games"—story problems involving everything from palindromes on speedometers to the intersection of hands on a clock—that my parents used years ago to entertain me on long car trips. By calling these questions "math games," my parents sparked an interest in mathematics that has continued to this day.

Acceleration

To be honest, I did not like math much during my first few years of school because I did not find adding or subtracting one-digit numbers either interesting or challenging. Although my teachers borrowed worksheets from other instructors for me, and my older brother brought home extra copies of his math homework, I was still unhappy with my schooling in math. Eventually the gifted and talented program in my school district permitted me to accelerate in mathematics, but I still found "school math" unchallenging, even while taking courses designed for students several years older than I.



The Wisconsin team claiming their third place trophies at the 1995 National MATHCOUNTS

The advantage of acceleration, however, was my early exposure to extracurricular math activities, such as the Wisconsin Math League. No longer did math consist of merely concrete ideas such as arithmetic, algebra, and geometry; now, it included difficult, complex, and abstract problems. I needed to apply the basic concepts from my math classes in different ways to solve intricate problems in a given amount of time. For example, one question asked for the product of ½, ⅔, ¾, ⅘, and so on until $^{99}/_{100}$. To actually multiply all the fractions would have been time-consuming, but once I saw that the numerators and denominators of subsequent fractions canceled out, the solution came easily. These types of math problems were challenging, and they sustained my interest through the remainder of elementary school.

First Competitions: MATHCOUNTS

By middle school, mathematics outside of school had become important to me, and I enjoyed competing with others. My family had heard of the MATHCOUNTS competition, but my school had never participated. When I was in seventh grade, we told the math department about it, and my school got involved in MATHCOUNTS for the first time.

I soon learned that MATHCOUNTS consisted of four rounds: sprint, target, team, and countdown. The sprint and target rounds, especially the latter, included abstract and challenging problems that required individually-written responses. The top ten scorers on those two rounds advanced to the countdown round, when a competitor would challenge the next-highest finalist on stage, one on one, in a setup similar to the quiz show *Jeopardy*. Team scores were calculated as the sum of the four individual scores and the score from the team round, a 20-minute written exam.

Coached by a school math instructor, the four members of my school team occasionally took practice tests, but we did not complete any substantial preparation. I went to the chapter and state competitions with very little background. As a result, although I finished fairly well, I did not advance to nationals. From this experience I learned that I could not rely on talent alone; I needed to study and prepare in order to succeed.

When my father became coach of my school's team the following year, I worked harder. This time, I qualified for the national competition and began studying with the three other students from Wisconsin's team. Although none of us placed in the top ten individually, each of us turned in a solid performance, and the teamwork and cooperation that we had learned helped us place third as a team. We were disappointed to learn, however, that one more correct answer would have placed us first. Again, this was a positive experience—I learned to accept that my tremendous effort and determination would not always guarantee success.

Exams, Talent Searches, and a Summer Program

The American Mathematics Competitions sequence was also a significant part of my extracurricular math experience. It began in middle school with the American Junior High School Mathematics Examination (AJHSME), which my school offered to interested students. Because I scored well in eighth grade, I was invited to take the American High School Mathematics Examination (AHSME) the same year, one year early. After earning more than 100 points out

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of the possible 150 on that exam, I was selected to take the American Invitational Mathematics Examination (AIME).

Although I did not score well enough on the AIME to advance to the next level, I was invited to join two math talent searches because I took the exams a year early. I have participated in the University of Wisconsin mathematics department's talent search since the eighth grade, and when I began high school, I was invited to participate in the USA Mathematical Talent Search (USAMTS).

After my freshman year, I attended the Young Scholars Summer Program (YSSP), a math summer camp for USAMTS participants at the Rose-Hulman Institute of Technology. I spent four weeks with 50 other high school students learning number theory, graph theory, problem solving, geometry, and other areas of math. The lectures were fascinating, and the informal weekly individual and team problem-solving contests encouraged me to study. Of course I learned a great deal of mathematics, but I also began to realize how much talent there was in the nation and the world. My horizons were broadened considerably, and I was inspired by the numerous close friends I made there.

The Road to an Olympiad

I felt energized by my positive experience at YSSP, and during my sophomore year I improved in music, sports, and academics by working harder and practicing more. In math, after taking the AHSME and AIME for the third time, I finally earned a high enough combined score to qualify for the USA Mathematics Olympiad (USAMO).

Wei (back row, far right) with several of her new friends at the Young Scholars Summer Program

Although I did not score well enough on the USAMO to qualify for the Mathematics Olympiad Summer Program, I achieved success in a different academic area: chemistry. After studying intensively for the qualifying exam and for the national exam of the United States National Chemistry Olympiad, I qualified for the two-week study camp at the Air Force Academy. Just as at MATHCOUNTS and at YSSP—and perhaps even more so—I was exposed to many very talented students. And again, this unique opportunity led to lasting friendships and additional motivation.

ARML: More Than Just a Competition

One of the most enjoyable math activities I have participated in is the American Regions Mathematics League (ARML). Both teamwork and individual talent are important keys to success in this fun annual competition held simultaneously at three sites around the nation. Every year the state of Wisconsin takes two teams of fifteen students each to Iowa City.

ARML consists of four rounds: power, team, individual, and relay. In the first and probably most difficult round, the power round, the fifteen students on the team cooperate to solve a multi-part problem. All parts of the problem require lengthy solutions, most asking for complete proofs. In the team round, students are asked to solve ten problems but need to submit only numerical answers. Next is the individual round, in which each student receives eight problems, two at a time. These problems are generally quite difficult; very few students have achieved a perfect score. Finally, there is the more laid-back relay round, in which students form five teams of three, and the second and third persons solve problems using answers from the teammate ahead of them.

Taking a break from the USNCO, Wei and other students on a hike near the U.S. Air Force Academy

To me, ARML is more than just another math competition. An annual reference point, this event has allowed me to reflect on each passing year and my growth—intellectually, socially, and emotionally—during that time. I believe that the majority of my development has been, either directly or indirectly, a result of the role mathematics has played in my life.

Mathematics outside of school has helped me in manifold ways. Exposure to so many talented students at competitions and camps has increased my determination and strengthened my work ethic. But I try not to stop with my own gains. When I arrived at my school, for example, the math club was virtually nonexistent. Over the years I have helped develop it and have, I hope, inspired others through my participation in extracurricular mathematics activities. π

Wei Ho is a junior at New Berlin West High School, where she plays on the varsity tennis team and works on the school literary magazine and newspaper. She also participates in the Academic Decathlon and debate, and plays violin in several orchestras.

113

1997 MATHCOUNTS medalists Reid Barton, Zhihao Liu, and Austin Shapiro

MATHEMATICS COMPETITIONS

The Mandelbrot Competition

A competition for high school students, the Mandelbrot is comprised of four rounds during the school year, each with an individual and team test. Topics include all non-calculus high school subjects, plus additions such as number theory. The Mandelbrot Midlevel was added this year for middle school students, and for the first time schools can participate via computer.

The Mandelbrot Competition
Greater Testing Concepts
P.O. Box 380789
Cambridge, MA 02238-0789
email: info@mandelbrot.org
www.mandelbrot.org

MATHCOUNTS

MATHCOUNTS is a national middle school competition. In February, more than 500 local meets are held across the country. Winners progress to state contests in March, and the top four scorers and top coach in each state earn an all-expense-paid trip to Washington, D.C., for the national finals in May.

MATHCOUNTS Foundation
National Society of Professional Engineers
1420 King Street
Alexandria, VA 22314-2794
(703) 684-2828
email: mathcounts@nspe.org
mathcounts.org

Math Olympiads for Elementary and Middle Schools

Five monthly contests are held from November to March. Each contest consists of five non-routine problems that require careful mathematical thinking. There is a division for grades 4–6 and one for grade 7.

Mr. John Lufrano
Math Olympiads
2154 Bellmore Avenue
Bellmore, NY 11710-5645
(516) 781-2400
email: moes@i-2000.com
www.moems.org/

American Regions Math League

High school students form teams of fifteen to represent their school, city, county, or state in this annual national mathematics competition held simultaneously at universities in Pennsylvania, Iowa, and Nevada. (For more details, see Wei Ho's article on page 14.) This year's competition will take place May 30, 1998.

Dr. Mark E. Saul, ARML President
711 Amsterdam Avenue
New York, NY 10025-6907
(212) 666-5188
email: 73047.3156@compuserve.com
www.rose-hulman.edu/~rickert/ARML/

USA Mathematical Talent Search

This contest for high school students encourages problem solving as an intellectual habit rather than a once-a-year activity. Four rounds of five problems each are mailed during the school year, and students have 30 days to complete their problem sets.

USA Mathematical Talent Search
COMAP, Inc.
57 Bedford Street Suite 210
Lexington, MA 02173
email: b.mcdonald@comap.com
www.nsa.gov:8080/programs/mepp/usamts.html

International Tournament of Towns

High school students in towns around the world participate via electronic mail in this mathematics problem-solving competition organized in Moscow and conducted in two stages.

Dr. Mark E. Saul
International Tournament of Towns
711 Amsterdam Avenue
New York, NY 10025-6907
(212) 666-5188
email: 73047.3156@compuserve.com
mech.math.msu.su/~razin/turgor/

The following four competitions are run by American Mathematics Competitions (AMC). For information, contact:

Dr. Walter E. Mientka, Director
American Mathematics Competitions
University of Nebraska
1740 Vine Street
Lincoln, NE 68588-0658
(402) 472-2257
www.unl.edu/amc/amcframe.htm

American Junior High School Mathematics Exam

The AJHSME covers subject matter normally associated with the seventh and eighth grade mathematics curriculum and may be taken by all students in grades 8 and below. The multiple-choice exam will take place November 17, 1998; high-scoring students will be invited to participate in the American High School Mathematics Exam.

American High School Mathematics Exam

Each February, 350,000 students nationwide participate in the AHSME, the first in a series of examinations that culminates in the International Mathematical Olympiad. The AHSME is a 30-question, multiple-choice, calculators-allowed exam, to be completed in 90 minutes.

American Invitational Mathematics Exam

The AIME is an intermediate examination between the AHSME and the USA Mathematical Olympiad. All students with a score of 100 out of a possible 150 on the AHSME are invited to take the AIME. The AIME is a fifteen-question, three-hour examination. Each answer is a three-digit integer, and all problems can be solved using precalculus methods.

USA Mathematical Olympiad

Approximately 160 of the top-scoring AHSME/AIME students (based on a weighted average) are invited to take the USAMO, a six-question, six-hour essay/proof examination. High scorers on the USAMO are invited to attend the Mathematical Olympiad Summer Program, and the six highest scorers represent the U.S. at the International Mathematical Olympiad.

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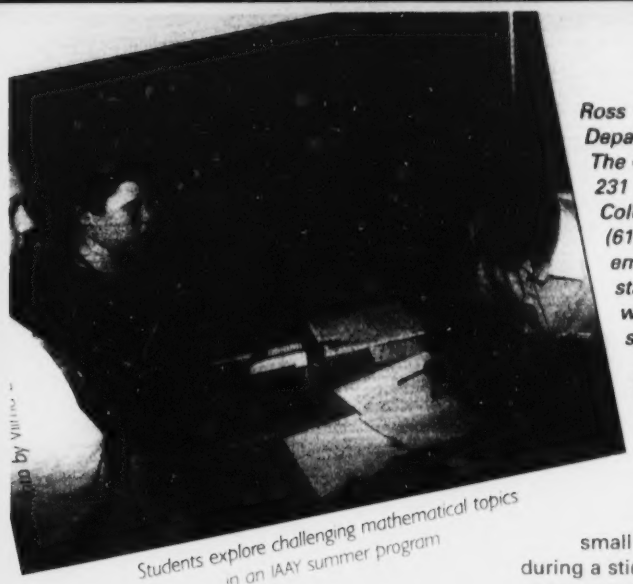


Photo by [illegible]

Students explore challenging mathematical topics in an IAAY summer program

SUMMER PROGRAMS IN MATHEMATICS

PROMYS

Each summer, approximately 60 high school students from around the country gather on the campus of Boston University for six weeks of rigorous mathematical activity. After attending a morning lecture on number theory, students spend the rest of the day working on problem sets. The problems challenge students to design their own numerical experiments and employ their own powers of observation to discover mathematical patterns.

PROMYS
Department of Mathematics
Boston University
111 Cummington Street
Boston, MA 02215
(617) 353-2563
math.bu.edu/INDIVIDUAL/promys/

The Ross Young Scholars Program

For eight weeks each summer, students ages 13–18 are immersed in a world of mathematical discovery at Ohio State University. First-year participants take the basic course in number theory that includes daily lectures and problem sets, supplemented by formal and informal discussions. Students are expected to attain mastery through exploration and experimentation. This "discovery" method of instruction aims at allowing students to find the key parts of the theorems, proofs, and even relevant definitions, by themselves.

Ross Young Scholars Program
Department of Mathematics
The Ohio State University
231 W. 18th Ave.
Columbus, OH 43210
(614) 292-1569
email: aer@math.ohio-state.edu
www.math.ohio-state.edu/ross/

Hampshire College Summer Studies in Mathematics

Exceptionally motivated and talented secondary school students work in small groups and as individuals during a stimulating six-week encounter with mathematics on the Hampshire College campus. Participants actively engage in the processes of mathematical thought, such as investigating concrete problems and applying insight and experience to the creation of proofs. Most of the faculty live on campus and join students for meals and recreational activities.

Summer Studies in Mathematics
Natural Science Department
Hampshire College
Amherst, MA 01002-5001
(413) 582-5375
email: dkelly@hampshire.edu
hamp.hampshire.edu/~kmdSP/Math.html

MATH RESOURCES

Web Sites

American Mathematical Society (AMS):
www.ams.org

Mathematical Association of America (MAA):
www.maa.org

Math Books Online:
www.maa.org/amazon/bookstore.html

MathMania:
csr.uvic.ca/~mmania/

Mathematical Problems and Textbooks

The MAA's "New Mathematical Library" series publishes competition problems from the AHSME through the IMO. To order, call 800-331-1622.

"Mathematical World," a series of books for advanced high school students published by AMS, includes such titles as *Intuitive Topology; Knots and Surfaces; Mathematical Circles;* and *Stories about Maxima and Minima.*

Another AMS series, "What's Happening in the Mathematical Sciences," reports developments in both theoretical and applied mathematics. Recent chapters focused on wavelets, mathematical modeling on Wall Street, and how a mathematician found the famous flaw in the Pentium chip.

To order books from AMS, call 800-321-4267.

Popular Press Books

Berlinski, David. *A Tour of the Calculus.* New York: Vintage, 1995.

Devlin, Keith. *Mathematics: The Science of Patterns.* New York: W.H. Freeman & Co., 1997.

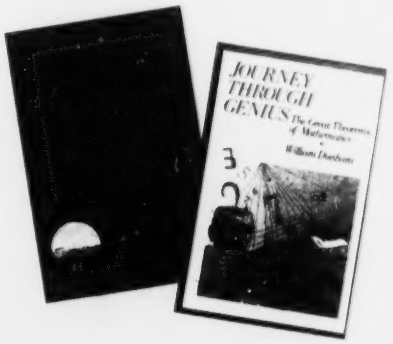
Dunham, William. *Journey Through Genius: The Great Theorems of Mathematics.* New York: Wiley & Sons, 1990.

Guillen, Michael. *Five Equations that Changed the World: The Power and Poetry of Mathematics.* New York: Hyperion, 1996.

Singh, Simon. *Fermat's Enigma: The Quest to Solve the World's Greatest Mathematical Problem.* New York: Walker & Co., 1997.

Stewart, Ian. *Nature's Numbers: The Unreal Reality of Mathematical Imagination.* New York: Basic Books, 1995.

These and many more resources are listed at jhunix.hcf.jhu.edu/~setmentr/links_54.htm



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Putting Math into Words

Interview with Ivars Peterson

by Melissa Hartman

A former high school math and science teacher, Ivars Peterson is the math and physics writer for Science News. *In addition, he edits* Science News Online, *for which he authors "MathTrek," a weekly math column. Mr. Peterson is the author of five books, including* Islands of Truth: A Mathematical Mystery Cruise, The Mathematical Tourist: Snapshots of Modern Mathematics, *and* The Jungles of Randomness: A Mathematical Safari.

Why does math interest you as a writing topic?

I have a fascination with the way things work. I have always loved books that show what's happening inside—gears, transistors, circuit boards. And in looking at how the gears and transistors work, I've seen the mathematical skeletons underneath. Once I learn these things, I get excited, and I want to explain them to other people.

Math is one tool that can help you understand what's going on behind the scenes. Math explains things that can be understood, and it can tell you why you may not understand something. It gives you reasons.

Why did you dedicate yourself to writing about math instead of becoming a mathematician?

I did very well in math in school, but I never really understood it—I just could do it. I scored very high on all the standardized tests all the way through school; I was always at the top in both English and math. But I'm not a natural mathematician. I don't consider myself that at all.

I have a hard time with just numbers on a page. I have to know where those numbers come from, what they mean, how they fit together. It wasn't until I started writing about math that I could see pictures and examples.

How did you get the background you needed to write about math?

I did a four-year honor degree at the University of Toronto in physics and chemistry. When I was an undergraduate, the University of Toronto had a reputation for its rigorous mathematics/physics/chemistry program, which was really a triple major.

Students in this program did the top-level math, physics, and chemistry, with labs and everything. But, as in high school, I found that the math was taught very abstractly. Although I took math all the way through, I focused more on the sciences.

I found it very interesting that the chemists, physicists, and mathematicians all taught their own version of math. In different sciences you learn the parts you need in order to solve specific problems, while in math you learn more general applications. In math you see the whole picture, only some of which is of actual practical value in a given situation.

I'm learning now that it's valuable to have the mathematician's perspective because it allows you to recognize the limitations of the equations you're using to solve a physics problem, for example. Math is behind the scenes everywhere, and that's why I'm always continuing to learn math.

After college, you taught high school math and science. Do you see a link between teaching those subjects and the kind of writing that you do now?

For me, the link is a very strong one. Teaching was a great experience. Being in the classroom gave me immediate contact with my audience. If you're at all alert as a teacher, you watch how students react to things, how they respond. And of course, you see on a test what they've learned and how well they've learned it.

When I taught physics, I did a demonstration every day, no matter how abstract the subject was. I found that when students could see the science at work, they got excited about it. I try to do that very much in my writing. I like to use colorful images, things that people can picture, hold, and play with in their minds.

What made you decide to leave teaching to pursue a writing career?

My real interest was always in writing. I'd always done a lot of writing in high school and grade school. I didn't write very much in college because I was taking so much math, physics, and chemistry, but it was always an interest. Even when I was teaching, I published a newsletter for

116 BEST COPY AVAILABLE

my classes just to show how much fun physics is.

But I got tired; teaching can be very draining, especially if you're doing lab courses. I wanted to refresh my mind. As a high school teacher I couldn't take a sabbatical, so I ended up leaving teaching to pursue a degree in journalism. I've been writing ever since.

What topic have you found the most interesting to write about?

I've written several articles for *Science News* about randomness, and my most recent book, *The Jungles of Randomness*, also treats this subject. I'm intrigued by limits—what we know and can't know. Where are those boundaries? Are there things that we can never work out, that we can never understand, that we can never know? The borderline between the knowable and the unknowable is a fascinating area.

You can never know something that's random, because it has no predictability. In *The Jungles of Randomness*, I tried to show how ideas of randomness come up in many different contexts, even in mathematics. People think that mathematics can give you absolute certainty, and it does, but in very limited areas. There are things in mathematics that we will never know. The same is true in physics, in biology, in everyday life. That doesn't mean that we should give up; it just means that there are limits. And where they are, and exactly what they are, is called research, it's called science, it's called learning. This is where all the exciting things happen.

It must be challenging, even with vivid examples, to make such complex topics accessible to a general audience. What technique have you found most useful?

The real trick is getting to what's most important about a subject, forgetting about the minute details, and recognizing the difference between the two. At *Science News*, we don't have much room to write things; even our feature stories are just two pages long. That means that I have to strip a pretty big concept to its essence. A lot of technical details that may seem very important to a researcher, for example, are not that important to my readers. I may have to leave out technically important details to add room for an analogy or a picture that a reader can relate to.

Does it take you a long time to write your articles?

That is actually decided by when the articles are needed. *Science News* is a weekly magazine with articles of different kinds and varying lengths. Some of my articles are in the works for months while I'm writing about other things. As one article is being edited, I'm usually halfway through thinking about and organizing what I'm going to do in my next article. As soon as I finish the article I'm working on now, I'll have scheduled another feature, and then another one due three weeks later. I'm juggling all the time.

With its system of theorems, proofs, and logical necessity, mathematics offers a kind of certainty. The tricky part lies in establishing meaningful connections between the abstract mathematical world that we create in our minds and the everyday world in which we live.

—from *The Jungles of Randomness*

And I actually write quickly. It takes me a long time to get started, but once I get started, I write very quickly—usually in a matter of hours, or in the case of two-page articles, in a day or two.

I count a lot on organizing and thinking things through in my mind. Even for the really fast news stories that have to be turned around in a day, I prefer to research and write out a quick outline and just leave it there. When I wake up the next morning, a lot of it is written already in my mind.

What do you find most challenging about the kind of writing you do?

In journalistic writing, you have to have a reason for writing a story. Something has to have happened. And in science and math, things happen in subtle ways. News reporting and writing is all based on events, and you have to find events in order to justify writing about something in science journalism. It could be a press conference or an announcement, a presentation at a meeting, a news release. Most often it's the publication of a paper in a journal. But that's artificial, because the research actually took place a year before. It's hard to fit math and science writing into that kind of situation.

I keep asking, why do I have to have an excuse? If I think a subject is interesting, I just want to write about it. That's where the book writing and "MathTrek," my weekly online column, come in.

What kind of training would you recommend to students interested in pursuing math writing?

If you're going to write about math, you don't need to have a math degree, but you must have an interest in math. You need at least a science degree because that will give you a lot of math. Even in journalism, you need a degree or a background in the area you want to write about. Science and math can move quickly, so you need to know something about the field. You can't just be a journalist—you need to have some kind of expertise; you need to have knowledge.

It also helps a tremendous amount to have an appreciation for words and a solid grounding in grammar and spelling. People tend to think that those are technical details, but those details allow you to express yourself clearly so that people understand.

Finally, good journalists are excited about learning—they want to know how and why. Personally, I think the more you know about more things, the better. I collect information of all kinds, and the best journalists I know have a vast store of miscellaneous knowledge. By having a broad knowledge, you'll prepare yourself to make connections, and whatever you learn can become something you might use in your writing. π

To read Ivars Peterson's "MathTrek," visit Science News Online at www.sciencenews.org

117

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Parting the Waters

The Rigors and Rewards of Crew

by Eric Clopper

Imagine pulling on an oar harder than you've ever pulled anything in your life. Think about extending your legs, leaning back, and wrenching the oar to your chest with every ounce of strength inside you. Every muscle in your body is exhausted, but you are dozens of strokes from the finish line. You feel blisters forming on your hands as you grip the damp oar. Imagine doing this voluntarily, absorbing the pain without ever—not even for a second—thinking about stopping. Welcome to crew.

I joined my school's crew team in the spring of my freshman year without really knowing what to expect. My brother and sister both rowed and had enjoyed the sport, so I decided to give it a chance. On the first day of practice at the Occoquan Reservoir, I met my future boat: eight other freshman guys of varying appearance, each unsure of what the year had to offer but hopeful of the possibilities. Eight of us would row, and the lightest freshman, the coxswain, would steer the shell from a seat facing us in the stern. Our coach, Jeff, was a former coxswain barely out of college who seemed excited to be back in the sport he loved.

"The Old Leak"

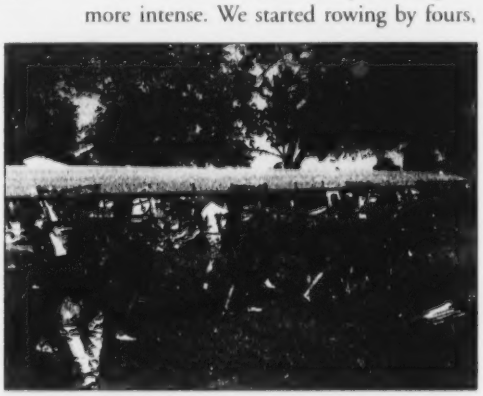
Because we were freshmen, we were assigned "the Old Leak," one of the team's oldest shells which, despite its name, floated. I remember the anticipation I felt sitting in my seat the first time we pushed the shell away from the dock. I was going to row, a sport I had watched many times but had never actually tried. As I took my first several strokes, my excitement grew.

We rowed in pairs that entire day. Two people would row and the others would rest and "set," or balance, the boat. A sense of calm swept through my body as I concentrated on keeping the shell even in the water. We glided slowly through the water alongside the beautiful wooded riverbank. The only sounds were the constant hum of my coach's launch, or motorboat, as he advanced beside us; the rhythmic clicks of the oars moving in the oarlocks during every stroke; and the musical whoosh of the water as the shell sliced through it.

When it was my turn to row, I focused on my technique and attempted to stay synchronized with the rower in front of me. My physical energy was channeled into propelling the boat forward. I gained most of my power by driving with my legs and sliding backwards on my seat. Then I finished the stroke by leaning back and bringing my hands to my chest. The challenge was to stay in time with my teammates: to drop our blades in the water together, pull through the stroke together, lift our blades cleanly from the water together, and swing the oars back into place for another stroke.

Hungry, Tired, and Happy

As the season continued, practices grew more intense. We started rowing by fours, then sixes, then finally all together. Sometimes it rained, and we rowed anyway. Sometimes the wind blew, and we desperately tried to steady the shell as the wind rocked it back and forth. Sometimes the river was choppy and waves washed over us, yet we kept rowing.



A modern 8-person shell is 60 feet long and weighs about 200 pounds.

Crew practice ended when it became too dark to see, so I usually got home about eight o'clock. My body and mind were exhausted. I was hungry, tired, and had homework to do for the next day. Yet I was happy. Each evening while I was on the water, problems and worries from school, home, and friends vanished from my mind. The stress built up from the day left my body through my oar. My grades improved because practice cleared my mind of mental distractions.

Docking at the Scholastic Rowing Association Nationals

But the biggest change in me had to do with my teammates. The eight others on my boat, whom I had only recently met, became the best friends I had ever had. The nine of us rowed together for several hours a day, five days a week, and the result was an incredible sense of unity. Anything one of us did in the shell, even just a slight shift of weight, would have an impact on the other eight. If I was feeling bad and couldn't concentrate, everyone else would know it. The boat would have a different feel. If I was concentrating better than usual, we would all row better.

A mutual respect had developed among us, and we began to bond outside of crew as

well, going to movies and parks and enjoying each other's company. Our friendship and team spirit would be important as we prepared to row against rival teams.

The Heat of Competition

A few months after we first paddled onto the river, we began to compete against other schools. After strong finishes in several local regattas, we had our first big race at the Stotesbury Cup Regatta on the Schuylkill River in Philadelphia, the oldest and largest high school regatta in the nation. We were optimistic going in, but we had a disappointing opening heat. Our boat didn't even advance to the semi-finals, although we finished with the fourth-best time overall. This result surprised me, and at first I was crushed. The disappointing finish, however, strengthened the bonds within our boat, because we had now shared not only in success, but also in defeat.

Rowing to the starting line before our first competition

Two weeks later, we had an opportunity to redeem ourselves at the Scholastic Rowing Association Nationals in Middleton, Delaware. We were hopeful about our chances at Nationals. After placing an easy second in our Friday heat, we advanced to the next round.

I can still clearly remember the thrill I felt at the starting line that Saturday morning. We had stretched and warmed up and were finally out on the water. We had spent months preparing for this one five-minute race, and I intended to put everything I had into it. I sat impatiently, repositioning my hands on the oar that was now almost an extension of my body. Our coxswain said a final few encouraging words. My entire mind was absorbed with this one race; all distractions had once again disappeared.

We locked our blades into the water, anchoring the shell and preparing for our first stroke. "All hands are down! Attention ... Row!" came the shout of an official, and I pulled on the oar with as much strength as I possibly could, my mind focused on the technique I had been practicing for months.

I don't remember a thing about the rest of that race except that I had nothing left when we crossed the finish line. I was completely winded after we stopped rowing and could barely walk once we docked. After regaining my strength, I learned that we had earned the fourth-fastest time, just as we had at Stotesbury. I was disappointed at not winning a medal, but I knew that we had rowed our best race ever. In that respect, we had succeeded.

The season seemed to end quickly after Nationals. We received an easy second-place medal in our regional championship. And although we did not win any awards at the national level, I felt satisfied with what we had accomplished.

In the off-season, I miss crew. I can't wait for another season of rowing to start: another season to be united with seven other rowers, a coxswain, our coach, our shell, and the water.

Eric Clopper, a sophomore at Thomas Jefferson High School for Science and Technology in Annandale, VA, is beginning his second season of crew. When on land, he is active in the school marching band, German Honor Society, and math team. He also plays piano and sings in his church's youth choir.

For information on Thomas Jefferson Crew:
www.tjhsst.edu/Activities/Athletics/Crew

A Classic Sport

The earliest known image of a boat with oars is found in a relief on a stone wall in Egypt that dates to 3000 BC. The course of early history was shaped in part by oars and the men, often slaves, who pulled them. Roman warships, Viking longboats, and Venetian galleys were all propelled by oar power.

The earliest known account in literature of rowing as a sport can be found in Virgil's *Aeneid*, in which a race is described at the funeral games held in honor of Aeneas's father.

Rowing as a modern sport developed on the Thames River in England, one of the world's great waterways. In the eighteenth century, when only the London and Chelsea bridges spanned the Thames, professional watermen operated ferry craft all along the river. Members of the gentry, for whom high-stakes gambling was a popular pastime, began wagering on the watermen. Organized competitions soon followed.

In 1716, Thames watermen competed in a five-mile rowing race from London Bridge to Chelsea. Known as the Doggett Coat and Badge Race, the contest is the oldest documented race in the world and still takes place today. The first regatta in the celebrated rivalry between Oxford and Cambridge Universities was held in 1829. Ten years later, the world's most prestigious amateur race, the Henley Royal Regatta, was founded. Rowing was adopted as an Olympic Games event in 1896.

Crew is the oldest intercollegiate sport in the United States. Yale started the first college boat club in 1843 and nine years later raced Harvard in America's first intercollegiate athletic event. Collegiate women's crew teams have competed since the 1970s, and today rowing is a popular sport on many college campuses. Teams are comprised of rowers who raced in high school as well as enthusiastic athletes who are new to the sport. College crew teams recruit novices willing to train before breakfast, practice in the afternoon, and compete on weekends in a classic sport that tests a person's physical and mental strengths.

Related Web Sites

The Rower's Resource
www.rowersresource.com

US Rowing
www.coxing.com/usrowing

The Rowing Service
users.ox.ac.uk/~quarrell

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Exploring Career Options: Advertising

Interview with Lori Campbell

by Lesley Mackay

Lori Campbell is creative director and owner of Dweck & Campbell advertising agency, a business she and her partner started in 1993. Now with a staff of seventeen, the company bills $20 million a year and services clients such as Time Warner, VSE Telecommunications, and Sarabeth's, a New York bakery and restaurant. Read on to find out why Lori's agency is known as a creative shop and how she got started in this exciting multimedia field.

How did you break into advertising?

I knew I wanted to go into advertising when I was in high school. I knew that my strengths were writing and the arts and that advertising could provide opportunities in one or both of those areas. At the University of Colorado at Boulder, I majored in journalism with a focus on advertising.

It was the 1980s, and when I graduated and consulted with a head-hunter, she encouraged me to break into the field by getting a secretarial job at an agency. I have always wondered if she would have given the same advice to a man. During my year as a secretary, I developed my portfolio at night, taking classes at New York City's School of Visual Arts. I also began working on my own time on two of the agency's accounts.

I learned a lot during the day by answering the phones and providing other kinds of assistance, but I wouldn't recommend starting out as a secretary to anyone. I think that the best approach is to make the focus of your life developing your portfolio. Having a good portfolio is essential to breaking into "creative" in advertising. It allows you to demonstrate your thinking in mock-ups.

What options are available to young people who want to break into the field today?

Few colleges in the country offer great advertising programs—Syracuse University and the University of Texas are exceptions. Generally, young people who want to go into advertising graduate from college and go on to attend an art center or a portfolio center—they offer the most help in preparing your portfolio. The best is probably Creative Circus in Atlanta.

Young people can break into advertising even earlier by obtaining internships. Virtually every advertising agency now offers internships, and they are a very good way to go. You don't even have to come to New York. San Francisco, Los Angeles, Minneapolis, and Atlanta also have very strong advertising communities.

When and how did you start your own business?

I started my own business after six years in the field; I was 29 years old. I have a partner who concentrates on the business side, while I concentrate on the creative side. That's typical in advertising. We didn't start with much capital—we were lucky enough to land a fairly large account right away. I approached an established client at the firm I was about to leave and made a formal pitch to take the account with us. We got it—in part because we could be ready right away. Before accepting my pitch, the owner asked, "Do you have a fax machine? Do you have a phone?" We set things up pretty quickly.

I think that another major factor in obtaining this client was that he believed that we were offering him the most creative ideas. In addition, he knew that, as our sole client, he would be of paramount concern to us. He sensed the total dedication that we would bring to the account.

One major account can be enough to get you started in your own company. Then, you want to concentrate on doing something big so that you can get regular media coverage for a campaign. Being aggressive about getting press—crossing over into the media—is essential to succeeding in advertising.

What kind of reputation does your firm have?

I think we're known as a very creative shop. While everything we do is based on a sound strategy derived from focus groups, I think our work gets talked about because of its creativity.

We've built our reputation with a range of very different accounts from Dial-a-Mattress to Seagrams to the Little Brown publishing division of Time Warner. We keep diversifying. For example, we are currently launching a campaign for a Miramax film *The Mighty* that's coming out in April.

Do you use many different strategies in your campaigns?

Absolutely. Our Dial-a-Mattress campaign, which was based in New York City, started out fairly traditionally with television, radio, and print ads. Then we added elements of guerilla marketing—for example, we placed print ads on pizza boxes saying, "We can deliver a mattress almost as fast." Guerilla marketing is exciting because sometimes you invent whole new media.

What do you do first when you get a new account?

Generally, we work with the client to contract out focus groups on consumer opinions relating to the particular product. We supervise the way that the focus groups

THE CHRISTIAN SCIENCE MONITOR
Crossing Desert to Get Dessert: Advertisers Go to New Lengths
Abu scoops up offer to travel desert for just desserts
BOSTON HERALD
Egyptian scoops ice cream company's offer to visit Hub for . . . Sweet dream
ABU TONIGHT
The Boston Globe
Business The Pitch: Ice cream
Scooping one another
National, local firms dish out big advertising bucks to keep consumers screaming for more

"Being aggressive about getting press—crossing over into the media—is essential to succeeding in advertising."
The Brigham's Ice Cream campaign, which received coverage in The Christian Science Monitor, the Boston Herald, and The Boston Globe—among other publications—was a tremendous success for Dweck & Campbell.

are conducted very closely. For example, before we created the Dial-a-Mattress campaign, we ran four focus groups of ten people each. Two of the groups were made up of users, and two were made up of non-users—people who had bought their mattresses the conventional way in stores. In the focus groups, people who had chosen Dial-a-Mattress told us why, and people who had chosen to buy in stores told us why they did that.

After we review the focus group findings, we figure out how to change the company image to convert people like the non-users in the future. Sometimes there is a little bit of sell involved in pitching our ideas. Focus groups help the agency and the client reach an agreement at the starting gate.

What's been your favorite campaign so far?

I'm proud of our Brigham's Ice Cream campaign. Brigham's is available only in Boston, so we designed a campaign based on the idea that sometimes the best things can be found in your own backyard. But, then, in an interesting twist, we pitched the idea far away. We placed ads in the *International Herald Tribune*, asking the question, "How far would you travel for Brigham's ice cream?" and providing readers with ways to respond. One respondent answered that he would ride a camel across the Sahara Desert for Brigham's.

Based on this response we went to the Sahara Desert and created a series of commercials that launched a new category in advertising—"the documercial." Every weeknight for a month during *Seinfeld* reruns, we ran different ads showing our camel-rider making his way across the desert for his ice cream. To promote the television ads, we handed out buttons and stickers that said "Abu is coming" at college campuses throughout Boston, and we posted flyers all over town. These items all had a phone number that people could call to find out who Abu was and to learn about the evening television ads. One of the flyers read, "Help! I need a sublet for me and my camel." The editor of the *Boston Herald* ran a two-page cover story on the campaign.

So, that campaign was a success?

It was. Anytime you cross over into the regular media, you are providing your client with free press and a much bigger audience than was paid for. Campaign success is often reviewed formally through tracking studies in which customers are called and questioned about the effectiveness of particular commercials or other campaign elements. Less formally, success can also be measured by the amount of buzz on the streets about a campaign. But actual sales increases over a given period of time are the ultimate measurement of a campaign's success.

Are there advertising campaigns that create buzz, that people enjoy and respect, but that do not improve sales?

A lot of things affect sales—advertising, the general economy, trends in an industry's performance. If people aren't buying cars, for example, the impact of a strong advertising campaign may be reduced. But I tell my clients that if there is some kind of recession, they should spend even more on advertising. When people have money again and are in the mood to buy, they'll remember a good campaign.

Please describe the creative process in advertising. How do you come up with your ideas, your breakthroughs? Do you think that the creative process is similar to, say, that of a novelist?

In advertising, the creative process is collaborative. We always work in teams—a copywriter and an art director. If someone has a bad idea, we figure that out quickly and move on. If someone has a good idea, we develop it quickly. The main difference that I see between the creative process in advertising and the creative process involved in writing a novel is that, in advertising, the writing is not as lonely.

Do you ever get creative block?

No. ■

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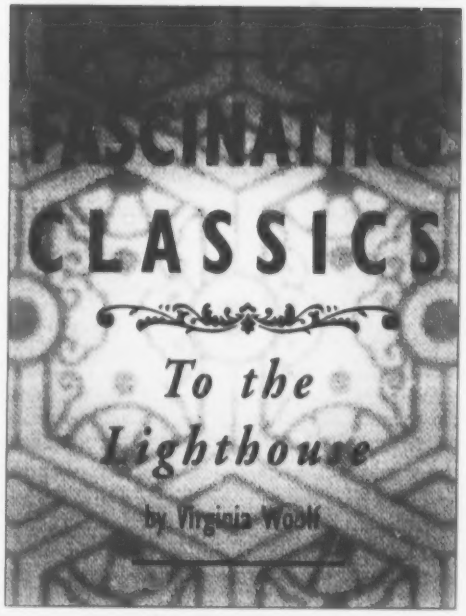
Review by
Lesley Mackay & Melissa Hartman



Lesley: Virginia Woolf's *To the Lighthouse* is a classic of the modern period, a slim, affecting book set in the British Hebrides Islands. Dominated by imagery of the sea—of sun, spray, deep water, and rocky shallows—this work evokes a stretch of time in the lives of Mr. and Mrs. Ramsay and their eight children, an educated, quirky, appealing British family. However, in its early pages, the novel begins to transcend its seemingly domestic focus, weaving the artistic quest of Lily Briscoe, a houseguest at the Ramsay summer home, deep into its narrative. For me, *To the Lighthouse* has depth, poignancy, and lightness—it is stirring and bright, like a crisp day at the sea.

Melissa: I love *To the Lighthouse*, too, Lesley, for its incredibly poetic style, its memorable characters, and its powerful meditation on artistry. The book is divided into three sections, all set at the Ramsays' island summer home. The first and longest, "The Window," captures the rich, almost unspoiled, texture of family life when children are young and no family member has yet been lost. The second section, "Time Passes," transports us to the unoccupied summer home off-season and years later in a poetic masterpiece that evokes the impact of unforeseen events. The third section, "The Lighthouse," builds toward a moving finale in which young James Ramsay and Lily Briscoe, back at the island, fulfill quests they initiated at the beginning of the novel.

Lesley: Woolf creates deeply sympathetic sketches of the Ramsays while brilliantly evoking the tumultuous feelings that family members often have for one another. The beautiful Mrs. Ramsay suffuses the novel. Charming and effective as a wife, mother, and hostess, she has a genius for unifying people. Sometimes, though, all she can do is to temper the words and actions of her imperious husband, a minor scholar who appeases his desire for greatness by dominating his wife and children. The Ramsay children, at different stages of youth, clatter back and forth between the airy, ramshackle house and the seashore, only fleetingly aware that they will not forever live in the warm, protective atmosphere created by their mother.

Melissa: Despite the Ramsays' strong presence in the novel, Woolf reveals her protagonist to be outside the family circle. Lily Briscoe, a 33-year-old painter, displays an even temperament, a questioning mind, and a courageous, experimental approach to her art.

In her work and in her life, Lily must contend with powerful external forces. Unmarried and inelegant, at the Ramsays' she is sometimes ignored, condescended to, and compared to her more alluring hostess. Charles Tansley, another guest and a disciple of Mr. Ramsay's, once told Lily that "women can't paint, women can't write," a veiled attack that Lily has never forgotten. Tansley feels much more sympathetically toward Mrs. Ramsay, picturing her with "stars in her eyes and veils in her hair, with cyclamen and wild violets." Mr. Ramsay's and Tansley's views reveal both sexism and a lack of imagination. At the beginning of the book, in a symbolic moment, Mr. Ramsay almost knocks down Lily's easel.

Lesley: Yet the image of Lily painting at her easel slowly takes over the narrative. Lily employs unconventional techniques to express her own aesthetics. Other painters of the day subscribe to seeing everything "pale, elegant, semitransparent...." But for Lily, "The jacmanna was bright violet; the wall staring white. She would not have considered it honest to tamper with the bright violet and the staring white, since she saw them like that."

Woolf portrays Lily's struggle to maintain her artistic integrity as epic; Lily confronts "terrific odds to maintain her courage; to say: 'But this is what I see; this is what I see,' and so to clasp some miserable remnant of her vision to her breast, which a thousand forces did their best to pluck from her."

Lily is clearly linked to Woolf herself, who tried in her writing to approach ever more closely the true nature of life and experience. In fact, Woolf takes a very painterly approach in this novel. Her depictions of the Ramsay family are *tableaux vivants*, colorful, impressionistic pictures—of Mrs. Ramsay presiding at a dinner party, of Mr. Ramsay pacing in his garden, of the young Ramsays looking for a lost brooch at the beach.

Melissa: Interestingly, these scenes are woven together in an associative rather than a linear way. For example, immediately after Mrs. Ramsay asks her daughter Prue if Nancy, another daughter, has gone to the beach, we read about what Nancy is doing at the beach and then return to Mrs. Ramsay at her dressing table. A traditional plot

Virginia Woolf and Vanessa Bell

Virginia Woolf completed *To the Lighthouse* when she was 44, Lily Briscoe's age at the end of the novel. She considered the book to be her most autobiographical, commenting that in it she "laid to rest" her powerful memories of her parents and of her childhood summers in a seaside community in Cornwall, England.

In its highly visual style and its emphasis on the accomplishments of Lily Briscoe, *To the Lighthouse* also pays homage to Virginia's most beloved sister, Vanessa Bell was a modern painter of portraits and landscapes and was a devoted friend to Virginia. The talented sisters sent each other letters almost every day, saw each other constantly, and vacationed together. They also shared the same friends, the Bloomsbury group, which mixed writers, such as Lytton Strachey and T.S. Eliot, with painters, such as Duncan Grant and Vanessa, and the renowned art critic Roger Fry.

Virginia's conversations with Vanessa, Fry, and others inspired what she called the "painting bits" in *To the Lighthouse*. However, Virginia wanted *To the Lighthouse* not only to contain ideas about painting, but also to introduce new fictional techniques inspired by modern painting. As Woolf's most recent biographer, Hermione Lee, wrote, Virginia

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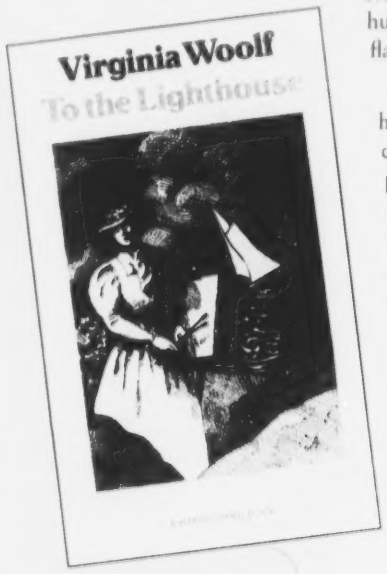
structure, in which chronologically arranged events lead to a climax and conclusion, does not exist in *To the Lighthouse*.

Yet Woolf threads a quest motif through the novel, an adventure story that parallels Lily's artistic pursuit. At the outset of the narrative, the six-year-old James Ramsay wishes to take a boat-trip to a nearby lighthouse. The possibility of going to this romantic, illuminated tower touches the little boy at the innocent center of his being.

While James and his mother talk about this voyage, the catalogue illustrations that he is cutting out become "endowed ... with heavenly bliss." But when the weather turns threatening, Mr. Ramsay states that his son will not be able to go. James's fragile hopes and Mrs. Ramsay's sympathy for them are presented in strong contrast to Mr. Ramsay's satisfaction in squelching their plan.



Lesley: To me, this opening scene is very moving. James's predicament beautifully expresses the vulnerability of all human beings both to time and to opposing forces, like the gathering storm clouds. Mrs. Ramsay intuitively understands that her son's desire is so pure and strong that only the sympathy of others can make it bearable. When Mr. Ramsay dashes his young son's hopes, she reacts with silent condemnation:

> *To pursue truth with such astonishing lack of consideration for other people's feelings, to rend the thin veils of civilisation so wantonly, so brutally, was to her so horrible an outrage of human decency that, without replying, dazed and blinded, she bent her head as if to let the pelt of jagged hail, the drench of dirty water, bespatter her unrebuked. There was nothing to be said.*

Melissa: Don't you find some irony, Lesley, in this melodramatic passage? Woolf illustrates how Mrs. Ramsay's legitimate outrage blossoms and becomes overblown. In this scene, Woolf attributes excessive emotions to all the characters, even lending murderous feelings to James: "Had there been an axe handy, or a poker, any weapon that would have gashed a hole in his father's breast and killed him, there and then, James would have seized it."

Lesley: You're right, Melissa, Woolf's irony is in high gear here. In fact, Woolf frequently adopts an ironic stance, blending the idealism and high sentiment of the novel with a willingness to expose the weaknesses and excesses of her characters.

She does this by using a stream-of-consciousness style, one that transcribes her characters' thoughts—and the uncertain, ambiguous, contradictory, and irrational nature of those thoughts. Woolf shows that her characters' interior lives reflect the same questions about "the nature of reality" that Lily addresses in her paintings.

Melissa: Lily's paintings also parallel the artistry that Mrs. Ramsay practices. Just as Lily strives to bring together light and shadows, and "to connect this mass on the right hand with that on the left," Mrs. Ramsay encourages people to come together. This is no easy task; even Mrs. Ramsay recognizes "the inadequacy of human relationships, that the most perfect was flawed...."

But while the novel portrays understanding and harmony among people as being elusive, it also conveys the huge value of those moments in which people do come together. For example, I find the scene in which Mrs. Ramsay throws her small dinner party to be truly moving. Mrs. Ramsay has achieved her greatest success within the confines of the narrative, bringing together a melange of friends and neighbors as well as six antsy children around a candle-lit dinner table. Enjoying the warmth of the gathering, the hostess reflects:

> *there is a coherence in things, a stability; something, she meant, is immune from change, and shines out (she glanced at the window with its ripple of reflected lights) in the face of the flowing, the fleeting, the spectral, like a ruby; so that again she had the feeling she had had once today, already, of peace, of rest. Of such moments, she thought, the thing is made that endures.*

Lesley: The dinner party scene is beautiful. For me, it is surpassed only by the quite different climactic scene in the final section of the novel. Lily composes outside at her easel, completing a powerful abstract painting, as the 17-year-old James Ramsay finally navigates a small boat to the lighthouse and thus shakes off the "tyranny" of his father. Lily puts the finishing touches on her painting:

> *It would be hung in the attics, she thought; it would be destroyed. But what did that matter? She asked herself, taking up her brush again.... [S]he looked at her canvas; it was blurred. With a sudden intensity, as if she saw it clear for a second, she drew a line there, in the centre. It was done; it was finished. Yes, she thought, laying down her brush in extreme fatigue, I have had my vision.* ■

attempted to re-create the beauty, immediacy, and color of Vanessa's impressionistic works in her novel by seeking "the essence of character through colour and form."

Vanessa judged that in *To the Lighthouse*, Virginia surpassed her. She complimented Virginia on capturing the "extraordinary beauty" of their mother and the brainy, rigid character of their father, adding, "So you see, as far as portrait painting goes, you seem to me to be a supreme artist...." Even Virginia, who was typically harshly judgmental of her own work, decided that she liked the book. In her journal she wrote, "Dear me, how lovely some parts of The Lighthouse are! Soft and pliable, and I think deep, and never a word wrong for a page at a time."

For Further Reading:

Lee, Hermione. *Virginia Woolf*. New York: Alfred A. Knopf, 1997.

Upcoming Fascinating Classic:

Ernest Hemingway, *The Old Man and the Sea*

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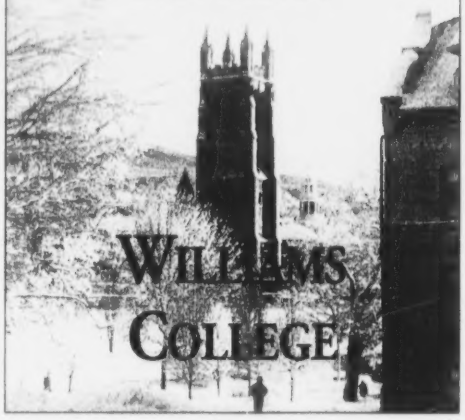
The College Review Series is intended to aid prospective college students in their search by offering insiders' views of selected colleges and universities, as expressed by current undergraduates or recent graduates who have high academic ability. Note that the number of reviewers is small. Consider their personal perspectives as only one component as you gather information and impressions from many sources.

STUDENTS REVIEW



Our reviewers include fourteen students, who major(ed) in chemistry (3), classics (1), computer science (1), economics (2), English (3), environmental studies (1), geology (1), history (2), math (4), physics (1), political science (2), religion (1), and women's studies (1). (The number of majors exceeds fourteen because several students completed double majors.) Students' comments appear within quotation marks.

Quality of Academic Instruction for Undergraduates

Reviewers gave the faculty high marks for their accessibility and commitment to teaching.

"The quality of instruction is superb. The college's focus is clearly on teaching, although many profs conduct outstanding research as well. Professors are amazingly available and make an effort to get to know individual students even in some of the larger classes. Classes generally have about twenty students, and while intro courses are larger (70–120), they are still tiny compared to those at large universities. All courses are taught by professors; TAs serve only as tutors and lab assistants."

"The college has no core curriculum, only divisional requirements. Students must take three classes in each of three divisions: arts & languages, social sciences, and science & math. It's not hard to find enjoyable courses to fulfill these requirements."

"Since there are no required courses and only vague distribution requirements, every student's education is in his or her own hands. The road to your diploma is yours to carve out; you alone will ultimately have to explain how you may have left some areas unexplored."

"The quality of instruction varies widely, ranging from outstanding to mediocre; careful selection can make all the difference. The math, economics, and art history departments are particularly strong, while Romance languages and psychology are considered weak. Although the library is somewhat limited, resources are exceptional for a school this size."

*"A true liberal arts college, Williams offers no preprofessional curricula, like journalism, architecture, or business. Professors try to teach us **how** to think, emphasizing critical and holistic thinking rather than mastery of work-related skills. They assume we'll be able to pick up the knowledge and skills elsewhere for whatever we choose to do after college."*

"Williams's 4-1-4 calendar is made up of two semesters and a January Winter Study Period, during which students take one pass/fail class outside the range of traditional academics. Students may design their own WSP programs; a friend of mine spent a month studying avalanches and skiing the slopes of Vermont."

Social Life

Williams's social life offers both the pleasures and limitations of a small college in a small town hours from the nearest major city.

"Social life is centered entirely on campus. The small college community is conducive to close friendships and a feeling of security; you at least recognize everyone here. With no frats or eating clubs, parties are typically open to the whole campus and range from small gatherings to dorm-sponsored dances. There are also movies, dance classes, and phys ed classes. Williams is a very active, outdoorsy campus with organized hikes, kayaking, canoe trips, mountain biking, and rock climbing in the surrounding Berkshire Mountains."

*"Nearly all students live on campus (and the housing is **fantastic**!). Important social ties are formed in the freshman 'entries' (dorms), which consist of 15–30 first-year students and 2–4 junior advisors. The entries are hotbeds of late-night intellectual discussion, providing a common experience that enables new students to come together."*

"If you need the excitement of a big city, go somewhere else. Besides skiing, extracurricular activity is on campus and centers around parties and small get-togethers. Some weekends get really boring, others are outstanding. Drinking is prevalent, but there's no pressure to drink. The relaxed academic atmosphere makes for a very relaxed social life (although at times that easy-going quality can feel like apathy)."

"Realizing that students are going to drink, the administration adopted a party policy. Every party must have a student host trained in first aid who will be responsible for anything that happens at the party and afterward. It creates a sense of awareness and accountability in the students."

"There's a remarkable lack of dating here. While some people find that frustrating, it has its advantages. There's no pressure to find someone to go out with, and people of the opposite sex are seen first and foremost as friends rather than as potential dates. This allows for close friendships with little to no sexual tension."

"Williams is quite isolated, and this should be a factor one considers seriously. However, it's not necessarily a negative. I now live in a large city, and while I enjoy the opportunities a city has to offer, I very much miss the sense of community that an isolated environment provides."

What Do You Like Best about Williams?

Reviewers concur that Williams is a very friendly and supportive campus.

"Without question, the best thing is the people. Both faculty and students are intelligent, thoughtful, and eager to help. Everyone comes to Williams excited about something, and for me this excitement was contagious. People who cherish close personal

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relationships tend to thrive in a small, tight-knit community like ours. We have fewer people than at a large school, but you can get to know more fully the people who are here."

"The people are ***so friendly****. No one is competitive; everyone is supportive. This sounds like an exaggeration, but it's true. People work hard, but they don't feel the same stress that my friends at other colleges complain about."*

"At such a small college, every participant is valued; no résumés are required to write for the newspaper or to participate in activities. Even though I'd had little or no involvement in journalism or leadership in high school, I became the opinions editor of the student paper and co-president of the student government."

"Williams's mathematics program—and its sciences in general—are stronger than at most comparable small colleges. Last year, Williams was the top-ranked small college in the national William Lowell Putnam Mathematics Competition. The class of '97 had 34 math majors—7% of the class, which is 7 times the national average."

"I love Winter Study Period. If you're fascinated by the class you're taking and sufficiently disciplined to fill your free hours well, WSP can be tremendous. This is the time for lingering conversations over meals and quality time with a book in front of the fireplace. For some, though, WSP is spent getting drunk to fill the hours of free time. If nothing else, WSP teaches that you are responsible for how you spend your time."

What Do You Like Least about Williams?

A small college inevitably has limitations.

"Williams is strong because it's such a small, self-contained community, but this can also be a liability. It can feel confining—parties can seem very repetitive—and the physical isolation limits off-campus social opportunities."

"The limited number and variety of courses offered. Advanced undergrads have no opportunity to take graduate-level courses. And some courses that could be offered are not, or are offered only every other year. Students with specific academic interests should look carefully at the catalogue and verify that courses of interest to them will be available."

"Though the Admissions Office will never admit it, most Williams students play a sport at the college level. In some ways, this emphasis hampers the development of other aspects of the community, as few athletes are involved in other extracurriculars. Trying to change this aspect of the student body has proven to be very hard. Year after year, athletes choose Williams while actors and artists feel that their place in the community would be very small and go elsewhere."

"While fall semester is beautiful, the winter can be long, muddy, dreary, and depressing. Before deciding to live in an area for four years, you should certainly determine whether the climate is something you can live with."

WILLIAMS COLLEGE

Williamstown, MA 01267
(413) 597-2211

- 4-year private coed college.
- Campus in a small town in the Berkshire Mountains of western Massachusetts.
- Full-time undergraduate enrollment 1997–98: 1,024 men; 957 women.
- Special features: Numerous junior-year-abroad programs; excellent athletic facilities; Clark Art Museum, with a famous collection of Impressionist paintings.

Who Would Be Most Compatible with the Academic and Social Atmosphere at Williams?

"Someone who doesn't need the excitement of a city; who plays a sport well but does much more; who values time spent in deep conversation; who seeks not merely a degree but also knowledge and self-discovery; who is patient enough to explain again and again, 'No, not William & Mary . . . it's a small college in western Massachusetts.'"

"Williams is an extremely accepting place. We have wonderful cultural diversity and awareness. Politically conservative students are a vocal minority, and some have found the curriculum and student body too liberal. The few handicapped students I know say that, with our messy winters, Williams is not an easy place to be handicapped."

"At first, I was struck by how homogeneous the student body seemed to be. After the visible diversity of my public high school, Williams seemed like an elite prep school, but at the college level. However, what cannot be stressed enough is the friendliness of the students. Once I started to get to know people, I found this place to be more diverse than I had originally perceived."

"While I don't think you'll find a better math department than ours among small liberal arts colleges, students planning to go to graduate school in math or science should weigh carefully the limitations of a small college. My own adjustment to grad school was, to be honest, rough. I went from being the top math student in my class at Williams to being about average at a top graduate program in math. Luckily I'd had a thesis advisor who exposed me to advanced topics I would not otherwise have seen, but my fellow grad students from larger schools were exposed to such topics in their regular course work."

If You Had It to Do Over Again, Would You Go to Williams?

All reviewers enthusiastically said yes.

"Yes. I love it. The intellectual yet non-competitive atmosphere has been terrific."

"Definitely! I've visited other schools, and nowhere else have I found people to be as happy, friendly, and comfortable as they are here. The work is tough, but the amazingly personal support from both professors and peers makes the challenges exciting rather than frustrating."

"Absolutely. Once you accept the limited social opportunities, it's fantastic. People are happy to be here. It's an open, accepting campus where faculty care and students matter."

"Yes. I believe that attending a small liberal arts college like Williams encourages a special reflectiveness. I'm very happy with the faculty, students, and opportunities here. And, at the end of four years, I think that saying farewell to the isolation will feel just right."

As you try to find the college or university best suited to you, the views presented above may be helpful. Keep in mind that these students might have had similar positive or negative experiences had they attended a different school. At any college, it is important to seek out challenging academic experiences and to create a social life that fits your personal style. ■

Note: The students quoted in the College Review Series are expressing their own views, which are not necessarily those of JHU or IAAY.

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PLANNING AHEAD FOR COLLEGE

Choosing High School Courses

by Linda E. Brody, Ed.D.

Spring is a busy time for high school students: in addition to fulfilling the ongoing demands of your academic and extracurricular interests, many of you are preparing for SAT and AP exams, beginning to think about finals, and planning for summer. It's also the time of year when you need to choose your courses for next year.

High school students worry a great deal about getting into a good college. But it's also important to focus on being prepared to do well once you get there. For this, you need solid academic preparation in high school, so you need to choose your remaining high school courses carefully.

Basic Requirements

When you begin to apply to college, you will see that many colleges suggest that applicants' high school programs include certain courses. Johns Hopkins, for example, recommends four years each of English and math, three years each of science and social studies, and two of a second language. MIT recommends four years of science but requires only two years of social science. Since colleges vary, check the requirements of the schools in which you are interested, but beware of taking only the minimum for a particular college. Your list of schools may change, and you don't want to find out senior year that your dream school requires two more years of math than you can possibly take before graduation.

However, it's not just the number of courses you take that indicates your readiness for college—the level of those courses is also important. If three years of high school math takes you through calculus, you may be able to replace the fourth year with an elective. But if your first three years take you only through precalculus, you will be behind most of your college classmates if you don't take calculus in your senior year. To be prepared to do your best in college, it's valuable to have as much content background as your classmates will have.

Honors and College-level Courses

A common question asked of college admissions officers is, "Is it better to get a B in an honors course or an A in a regular course?" The typical response is, "Try to get an A in the honors course." The consensus is that, even if you don't get perfect grades, you should take the most rigorous program offered by your school if you plan to attend a selective college. In fact, selective colleges may ask your guidance counselors whether you took the most academically challenging courses available in your high school. If the answer is no, there may be concern about your readiness for a tough college curriculum.

In addition to honors courses, take full advantage of opportunities to enroll in college-level courses. These include Advanced Placement and International Baccalaureate courses, as well as courses taken at a local college or university. Experience with rigorous college-level work in high school will hone your study skills and expose you to the level of instruction you will soon encounter in college.

Elective Courses

While most of your high school program will consist of core liberal arts courses, you'll also want to consider electives. Depending on your interests and talents, you may want to study art or music, computer science or science research, or another language. You might also explore special opportunities at your school, such as the chance to work with a mentor.

Choose electives on the basis of genuine interests and skills you hope to develop, not in an effort to take less challenging courses to boost your GPA. Colleges will recognize the difference when considering your application, and you shouldn't waste time on courses that aren't a genuine learning experience for you.

Considering Early Entrance to College?

Some highly able high school students complain about a lack of challenging courses in high school. If your courses seem too low-level or if you're running out of options, you might consider entering college full-time before completing high school. Research supports early entrance as a viable option for many academically talented students. However, if you decide to enter college early, you still need to be concerned about having adequate academic preparation to be successful.

A study of early entrants to Johns Hopkins found the number of Advanced Placement courses taken to be the best predictor of their success in college.* Though these students entered young, those with AP course work were well-prepared with the content knowledge needed to compete in classes with older students who had completed four years of high school. If you're entering an early entrance program designed for high school students, AP course work may not be necessary, but be sure your writing and mathematical skills are adequate for the program you are entering.

If full-time early entrance isn't appropriate for you, part-time college and distance learning courses, in addition to honors and AP classes, can do much to make high school more challenging.

Before entering high school, work with a counselor to develop a four-year plan, and re-evaluate that plan every year in light of changing goals and opportunities. Whether you're math and science oriented or more interested in the humanities, a broad background in all of the liberal arts is important. As you choose your courses for next year, seek those that will expand your knowledge, develop your thinking and writing skills, and give you the preparation you need to excel in college.

* See "Five Years of Early Entrants: Predicting Successful Achievement in College," by L.E. Brody, S.G. Assouline, & J.C. Stanley, *Gifted Child Quarterly*, Fall 1990.

If you're planning for college ...

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Math Challenge: Problems from the 1998 AHSME

If you took the American High School Mathematics Exam this February, here's a chance to compare some of your solutions to those provided by the American Mathematics Competitions. If you haven't yet taken the AHSME, these problems provide a taste of what you can expect.

Problems

1. Let R be a rectangle. How many circles in the plane of R have a diameter both of whose endpoints are vertices of R?

   (A) 1 (B) 2 (C) 4 (D) 5 (E) 6

2. How many different prime numbers are factors of N if $\log_2(\log_3(\log_5(\log_7 N))) = 11$?

   (A) 1 (B) 2 (C) 3 (D) 4 (E) 7

3. Walter rolls four standard six-sided dice and finds that the product of the numbers on the upper faces is 144. Which of the following could **not** be the sum of the upper four faces?

   (A) 14 (B) 15 (C) 16 (D) 17 (E) 18

4. A parabola has vertex at (4,–5) and has two x-intercepts, one positive and one negative. If this parabola is the graph of $y = ax^2 + bx + c$, which of a, b, and c must be positive?

   (A) only a (B) only b (C) only c (D) a and b only (E) none

5. Let $f(x)$ be a function with the two properties:
   (a) for any two real numbers x and y, $f(x + y) = x + f(y)$, and
   (b) $f(0) = 2$.
   What is the value of $f(1998)$?

   (A) 0 (B) 2 (C) 1996 (D) 1998 (E) 2000

6. A right circular cone of volume A, a right circular cylinder of volume M, and a sphere of volume C all have the same radius, and the common height of the cone and cylinder is equal to the diameter of the sphere. Then

   (A) $A - M + C = 0$ (B) $A + M = C$ (C) $2A = M + C$
   (D) $A^2 - M^2 + C^2 = 0$ (E) $2A + 2M = 3C$

7. Three cards, each with a positive integer written on it, are lying face-down on a table. Casey, Stacy, and Tracy are told that
   (a) the numbers are all different,
   (b) they sum to 13, and
   (c) they are in increasing order, left to right.

   First, Casey looks at the number on the leftmost card and says, "I don't have enough information to determine the other two numbers." Then Tracy looks at the number on the rightmost card and says, "I don't have enough information to determine the other two numbers." Finally, Stacy looks at the number on the middle card and says, "I don't have enough information to determine the other two numbers." Assume that each person knows that the other two reason perfectly and hears their comments. What number is on the middle card?

   (A) 2 (B) 3 (C) 4 (D) 5 (E) There is not enough information to determine the number.

Solutions

1. (D) The four vertices determine six possible diameters, namely, the four sides and two diagonals. However, the two diagonals are diameters of the same circle. Thus there are five circles.

2. (A) Note that $N = 7^{5^{3^{11}}}$, which has only 7 as a prime factor.

3. (E) Factor 144 into primes, $144 = 2^4 \cdot 3^2$, and notice that there are at most two 6s and no 5s among the numbers rolled. If there are no 6s, then there must be two 3s since these are the only values that can contribute 3 to the prime factorization. In this case the four 2s in the factorization must be the result of two 4s in the roll. Hence the sum $3 + 3 + 4 + 4 = 14$ is a possible value for the sum. Next consider the case with just one 6. Then there must be one 3, and the three remaining 2s must be the result of a 4 and a 2. Thus, the sum $6 + 3 + 4 + 2 = 15$ is also possible. Finally, if there are two 6s, then there must also be two 2s or a 4 and a 1, with the sums of $6 + 6 + 2 + 2 = 16$ and $6 + 6 + 4 + 1 = 17$. Hence 18 is the only sum not possible.

   OR

   Since 5 does not divide 144 and $6^3 > 144$, there can be no 5s and at most two 6s. Thus the only way the four dice can have a sum of 18 are: 4,4,4,6; 2,4,6,6; and 3,3,6,6. Since none of these products is 144, the answer is (E).

4. (A) Because the parabola has x-intercepts of opposite sign and the y-coordinate of the vertex is negative, a must be positive, and c, which is the y-intercept, must be negative. The vertex has x-coordinate $-b/2a = 4 > 0$, so b must be negative.

5. (E) Note that $f(x) = f(x + 0) = x + f(0) = x + 2$ for any real number x. Hence $f(1998) = 2000$. The function defined by $f(x) = x + 2$ has both properties: $f(0) = 2$ and $f(x + y) = x + y + 2 = x + (y + 2) = x + f(y)$.

   OR

   Note that $2 = f(0) = f(-1998 + 1998) = -1998 + f(1998)$. Hence $f(1998) = 2000$.

6. (A) Suppose the sphere has radius r. We can write the volumes of the three solids as functions of r as follows:
   Volume of cone $= A = \frac{1}{3}\pi r^2(2r) = \frac{2}{3}\pi r^3$,
   Volume of cylinder $= M = \pi r^2(2r) = 2\pi r^3$, and
   Volume of sphere $= C = \frac{4}{3}\pi r^3$.
   Thus, $A - M + C = 0$.

7. (C) There are eight ordered triples of numbers satisfying the conditions: (1,2,10), (1,3,9), (1,4,8), (1,5,7), (2,3,8), (2,4,7), (2,5,6), and (3,4,6). Because Casey's card gives Casey insufficient information, Casey must have seen a 1 or a 2. Next, Tracy must not have seen a 6, 9, or 10, since each of these would enable Tracy to determine the other two cards. Finally, if Stacy had seen a 3 or a 5 on the middle card, Stacy would have been able to determine the other two cards. The only number left is 4, which leaves open the two possible triples (1,4,8) and (2,4,7).

Additional problems and solutions from past competitions are available in books from the MAA. For ordering information, and for more details about the AHSME and other mathematics competitions, see pages 16–17.

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Knossos Games

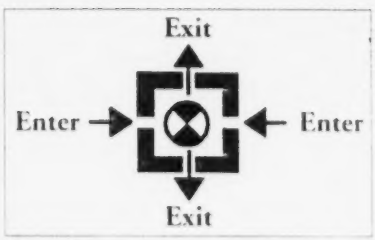
by Tim Boester

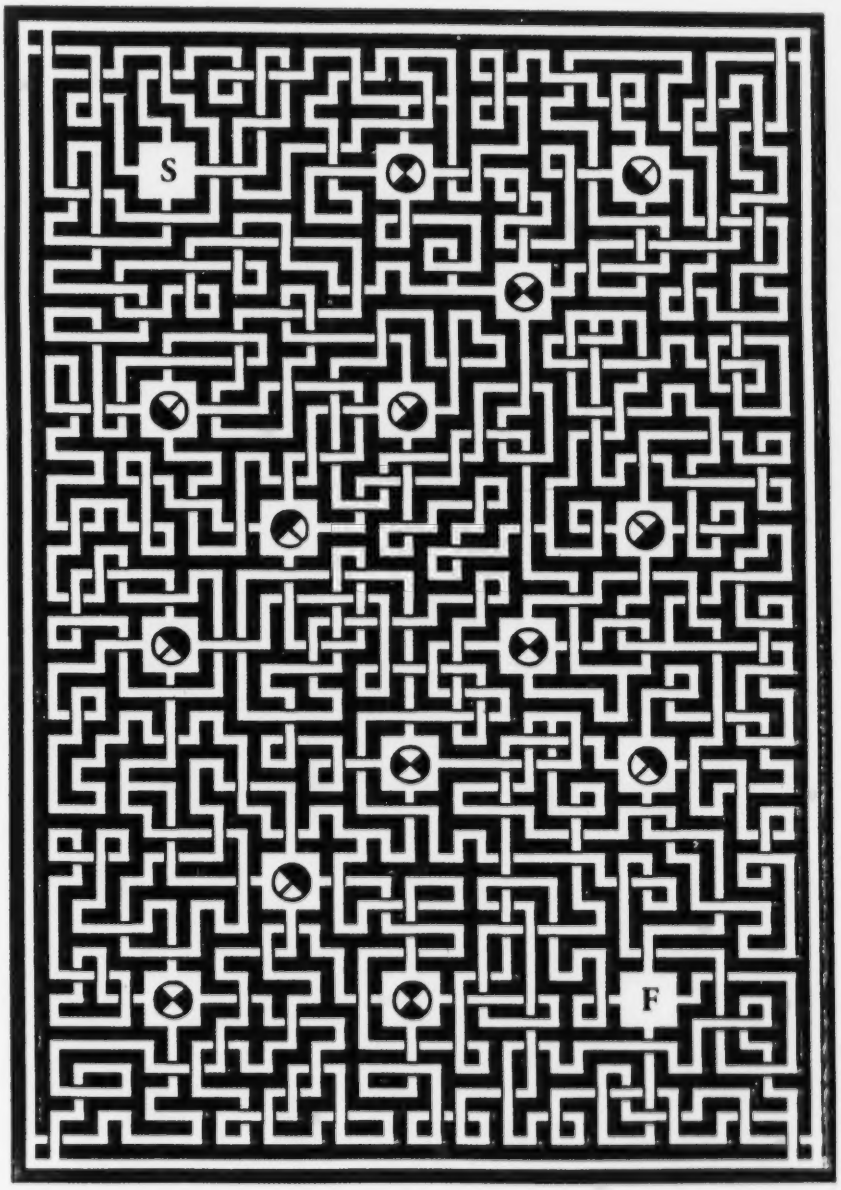
*A fourth-year mathematics student at the University of Chicago, **Tim Boester** is fascinated by puzzles and mazes. He is currently applying to graduate school, where he plans to continue his mathematical pursuits.*

The Goal:
Go from Start to Finish passing through all but one of the rooms with circles.

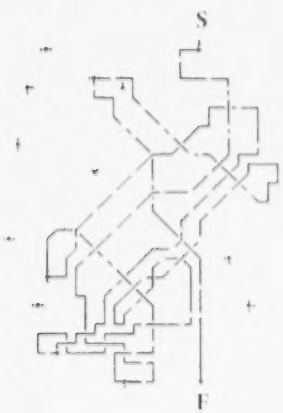
The Rules:
The circles indicate permitted entry and exit points: you may enter a room only at a white quadrant and exit only at a black quadrant (see example).

You cannot retrace your path or visit a room more than once.





Solution to Knossos Games in our January/February issue:



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VOLUME 5, NUMBER 5

ImaGiNe...

Opportunities and Resources for Academically Talented Youth

May/June 199

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Students Review Northwestern University

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FROM THE EDITOR

Dear Reader,

This year, we at *Imagine* have created issues exploring various worlds: biology; literature, language, and linguistics; public service and politics; mathematics; and, with this issue, multimedia communications. As always, our publication has illuminated a range of educational opportunities and activities in each field. As always, we have profiled students who have forged new paths of learning and creative activity.

This issue features many exciting examples of young people whose inventiveness has expanded the range of human expression. From developing a Web site (and sowing the seeds of a new business), to spinning CDs on a radio station, to mastering the complexities of television production, students show how school-based activities can lead to new interests, skills, and even careers. A professional computer animator explains how technology has enabled him to translate his visual skills into computer art programs, realistic animated characters, and short films. An amateur teenage historian describes how the medium of film allowed her to create a "permanent visual memory" of heroines from her hometown. Throughout the issue, our contributors demonstrate that personal initiative can ignite the possibilities of technology to create powerful new forms of communication.

Next year, we will continue to inspire you with accounts of student accomplishments as well as information and insights that can guide you toward new challenges and adventures. The next volume of *Imagine* will explore the following focus topics:

- **Environmental Science**
- **The Performing Arts**
- **Engineering**
- **Cross-Cultural Studies**
- **Career Discovery**

Imagine can help you take charge of the coming school year, plan effectively for college, and even shape a career. Where else can you find articles and creative work by students, college reviews, career profiles, reviews of classic novels, puzzles, math challenges, and current information about programs, competitions, internships—all in one publication?

1998–99 promises to be an exciting year for *Imagine* and for you. We hope you'll join us again in September to discover even more ways to make your precollege years challenging, fulfilling, and fun.

Melissa Hartman

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Imagine...
Opportunities and Resources for Academically Talented Youth™

ISSN 1071-605X
Volume 5 • Number 5
May/June 1998

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Published five times a year—September/October, November/December, January/February, March/April, and May/June.

Application to mail at Periodicals Postage Rates is approved at Baltimore, MD, and additional mailing offices.

POSTMASTER: Send address changes to *Imagine*, The Johns Hopkins University Press, Journals Publishing Division, P.O. Box 19966, Baltimore, MD 21211.

Imagine is published by the Johns Hopkins University Press for the Study of Exceptional Talent (SET) at the Johns Hopkins Institute for the Academic Advancement of Youth (IAAY). This publication is an outgrowth of newsletters and programs that, for twenty-five years, have served highly talented students identified by the Study of Mathematically Precocious Youth (SMPY) and by SET.

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Annual subscription: $30.00

Address subscription inquiries to:
Journals Publishing Division
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On the cover:
Chiun Kim, Megan Cooper, and Peter Shanel edit a film they created at the Institute for Television, Film, and Radio Production. Photo by Boston University Photo Services, courtesy of ITRP.

CONTENTS

Focus On: Multimedia Communications

Art and Craft
As a teenager, Cassidy Curtis was fascinated by computer graphics he saw on TV. Now he's using computers to simulate watercolor effects, to create "hand-drawn" sketches, and to make noodles dance 4

Bringing Teen Voices to the Web
Daniel Jackson takes you behind the scenes at In-Site, *an online magazine written, edited, and coded by students* 6

Four Friends and a Home Page
AJ Shankar reflects on the experiment in HTML that he and his friends undertook a few summers ago—and its unexpected results 7

A Summer Internship at Bell Labs
Why should high school students consider internships in multimedia applications? Scott Aaronson, who spent ten weeks working as an intern on an interactive Web site, explains 8

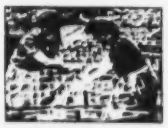
Tuning in to High School Radio
In three years of working at WKWZ, Jason Weill has learned that radio involves much more than playing CDs 9

Out of the Living Room, Into the Control Room

Put down the clicker and hit the studio! Opportunities abound for students interested in television production 10

Education at a Distance
Looking for ways to expand or accelerate your coursework—without leaving home? Consider our list of selected distance learning opportunities 13

Women in the Wings: Julia Love, Filmmaker, in the Spotlight



After learning about the secret manufacture of World War II military gliders in her hometown, Julia Love decided to tell the story of the women who made them 16

Still Life with Movement: Video as Art

It all started with a Sony Portapak. Now video art encompasses many forms of artistic expression, and it's coming soon to a museum near you 18

Exploring Career Options: Immunology
Interview with James Hildreth, M.D., Ph.D. . . . 20

The 57th Annual Science Talent Search
As always, this year's top STS projects reflect a range of scientific and mathematical curiosity 23

Fascinating Classics
Ernest Hemingway's The Old Man and the Sea . . 24

Students Review Northwestern University 26

Planning Ahead for College
Visiting campuses during the summer can help you make important college decisions—and provide a fun vacation for your whole family 28

The Coach's Corner 29

Creative Minds Imagine
Artwork by Amanda Brainerd and Janine D'Adamo 31

Knossos Games 32

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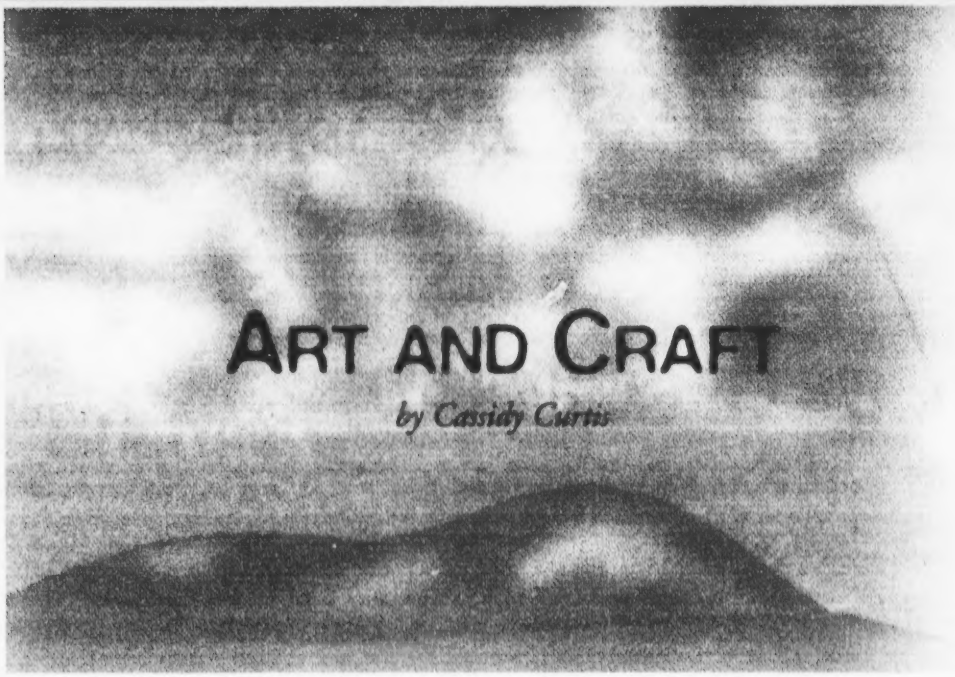


Art and Craft

by Cassidy Curtis

A lot of people think that because I'm a computer animator, I must be an accomplished artist. But I know some people who are artists, and I'm definitely not that. I'm just a guy who draws.

I was a kid who drew all the time. In high school I took whatever art classes I could, and I later took classes at the Art Students' League in New York. But it was computer graphics, not my background in the visual arts, that got me interested in becoming an animator.

When I was a teenager, I was enthralled by the computer graphics that started to show up on TV and in the movies. At the time, I thought these effects were created by imposing men in suits who worked in skyscrapers in Manhattan. I had no idea that this was something I could do. But eventually I got my own computer, and by the time I got to college, I had done some computer graphics on my own.

In college, I worked with a professor who was interested in mathematical visualization, and he helped me get started doing computer graphics programming. This experience led me into computer animation, which has recently led me into animation in general. That's an unusual route; most of the animators I know went to art school. For some of them, their job was their first brush with computers at all.

The Evolution of Animation

With the growing use of computers in animation, you might think that the processes used to create the old Bugs Bunny cartoons have been discarded. But cel animation, or traditional animation, still exists. An animator creates the key poses, and then people called "in-betweeners" fill in all the in-between frames. These people are really good at interpreting the key poses and creating a natural-looking motion between them. That unique talent has yet to be replaced by computers.

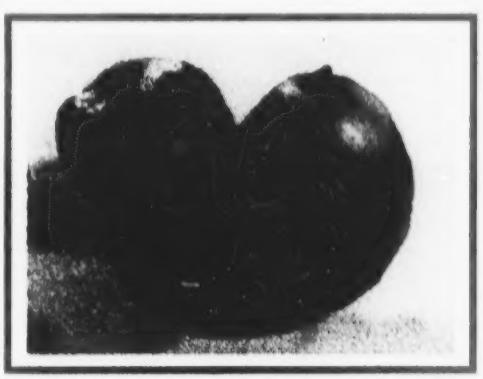
But the computer has been able to speed up many processes, such as the ink-and-paint process. The in-betweeners used to give their pencil drawings to another team responsible for drawing the lines with ink and filling in the colors. Now, a lot of that is done digitally.

But the real changes have taken place in new branches of animation, such as 3D animation. As it's developed over the years, computer animation has drawn a lot not only from cel animation, but also from cinematography, in terms of how to frame a shot, how to place a camera, how to light a scene. You can see the influence of both cinematography and cel animation—particularly in motion and lighting—in movies like *Toy Story*.

Today, animation is infinitely flexible. In fact, I think we're at a point where any image that a director or an artist can conceive of can be created with the help of computer animation. What can be done in the movies is limited only by the amount of time, energy, and money that can be spent on the project.

As a result of this flexibility, animation now serves more purposes than ever. In addition to providing entertainment, computer animation also has scientific, medical, and mathematical applications. For example, computer animators can generate a digital model of an organ, muscle, or bone, allowing doctors to see what they're studying without conducting surgery or dissection.

It also has uses beyond the fields of math and science. In the legal profession, computer animation can be used to reconstruct events. By integrating forensic evidence and witnesses' descriptions of events, computer animators can make a video showing what actually happened, which can be used in the courtroom as evidence. Computer animation can even be used in engineering: there's a company called Failure Analysis that analyzes bridges and large-scale construction projects, visually representing things that can and do go wrong for the purpose of building things more safely.



Watercolor painting? Not exactly: this is a computer-generated image created using a program Cassidy wrote to produce watercolor effects.

All of these applications suggest that if you know computer graphics, you can work in almost any field.

Making Noodles Dance

If you want to work in computer graphics as an animator, you'll need a sense of timing, a sense of motion, and most important, strong visual skills. The ability to see things in your head will take you a long way. I think I was lucky in that regard—I had a hard time with abstract mathematics, but anything that could be

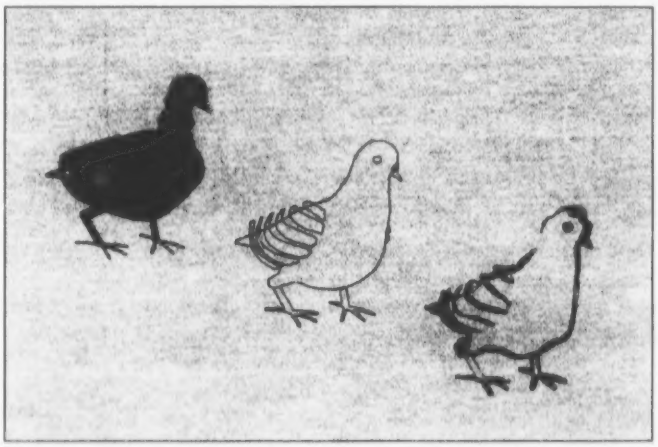
perceived as a shape or a volume or a surface, that I could turn around in my head, I could understand.

While I have relied on my visual skills, pure mathematicians who don't work as visually can do great work in this field. Computer graphics is a part of computer science; it is built on algorithms, and algorithms don't have to be visualized. For example, if you can come up with a really efficient sorting algorithm—sorting has to be done even in computer animation programs—you can be involved in computer graphics as a purely technical person.

I always encourage my students to keep their experience broad: I advise art students to take a programming class so they can see what it's like to build a program that does their work for them. And I recommend that computer science students take a drawing class so they can understand the experience of trying to represent the world on a piece of paper. You don't have to be an expert at both to do well in computer graphics, but you certainly want to have some experience with both.

A typical production environment brings together people with these different skills. I worked on a fun commercial for Kraft Velveeta that involved every aspect of animation production. The premise of the commercial was that macaroni noodles prefer Velveeta to other kinds of cheese because it melts better. The commercial featured a flock of happy, dancing, jumping macaroni noodles and a live-action four-year-old kid who looked on in awe as the noodles danced around. We were given a background plate of a table top, a box of noodles, and a kid looking across the table as if there were noodles there. Our job was to put the noodles into the scene and make them look real, and a lot of details went into making that work.

The process started with a model, a digital representation of a three-dimensional object. A relatively simple object, like a noodle, can be built in one of the many available 3D modeling programs. For a complicated object, like a human face, a traditional sculptor will build a model out of clay. The computer modeler will then scan and digitize that model.



In the short film Brick-a-Brac, Cassidy began with a three-dimensional model and, with the help of a computer, translated it into what looks like a hand-drawn image.

In the case of the Velveeta project, the model was built directly in the computer. My job was to put a little skeleton inside the model so that it could be animated, to design the deformations that would enable it to bend, and to make sure that when it did bend it would still look like a noodle. After I put in the skeleton, I handed it off to the character animators. At this point, the model was a lot like a marionette; it was the character animators' job to pull the strings in such a way that the noodles would come to life and act.

In one of his many attempts to use a computer to represent the real world, Cassidy created this animation that simulates the effects of cream poured into coffee.

There was also a lighting person whose job was to give each noodle a realistic texture and to put lights into the virtual world that made the noodles look like they were in the real world. And since the table top was made of tile, this person had to create shadows and reflections of the jumping noodles.

The Computer as Brush and Ink

While I love working in a group of people with all of these distinct talents, one of my favorite projects was actually one in which I performed all of those roles myself. I had just started working at Pacific Data Images, where they had a policy of giving trainees a window of time during which their only task was to create a small project from scratch and see it through to completion. I took advantage of that and started working on trying to make computer animation look like something other than 3D plastic objects moving around.

I wanted to do a short animation that looked like a drawing. But since I didn't have the experience in traditional animation to do hand-drawn animations, I had to write software that would convert a three-dimensional animation into a hand-drawn animation. That was what I did for *Brick-a-Brac*, my short film about a pigeon who likes to hit his head against a brick.

To turn a 3D animation into something that looked hand-drawn, I first built a model of a pigeon in 3D and animated it by moving its joints and changing its positions in 3D space. After creating images of those different poses, I used an automatic tracing program to find the edges of the silhouettes of the pigeon's wings, beak, and body. Then I rendered those edges as if they had been drawn, incorporating the subtle characteristics of a hand-drawn line—the variations in thickness, the textural qualities, and even little splotches of ink. The computer performed that process on every single frame in the animation, and the result is an animation that looks like it was drawn by hand.

Continued on next page

Continued from page 5

In the same way that *Brick-a-Brac* looked like it was created with a brush and ink, I wanted to do an animation that looked like it was done with watercolor painting. I love watercolor for its luminous quality, transparency, and wonderful range of textures. In my project on computer-generated watercolor effects, I tried to capture some of that in a computer algorithm that could be used to produce those qualities on demand.

While I was working on the project, I discovered that when you paint with watercolors, the paint continues to move and flow, and the shapes don't stay static. That became part of the project as well—simulating not only the finished painting, but also the process of making the painting.

I was motivated to pursue this project because I found watercolors fascinating to look at. That's where the motivation for a lot of my work comes from. I see something in the real world, like a cloud in the sky, and I wonder, what makes that work? By understanding the way that this thing works, could I make a picture that behaves the same way? Could I make an animation that moves the same way as that cloud or that paint or the cream when I pour it into my coffee?

A large part of work like this is just getting excited about the real thing and then using what you know about math and physics and human perception to control the effect. If you're in production, you need this control because an artistic director tells you what he or she wants the finished product to look like. But this control—the process of interpreting and making sense of the world and then writing a computer program that will do the thing that is so fascinating to you—is completely satisfying in its own right. ■

After earning a B.A. in mathematics from Brown University, ***Cassidy Curtis*** *began his career in computer graphics. Now a researcher and instructor at the University of Washington, Cassidy has worked on animation projects including MTV's Top 20 Video Countdown, the 1994 movie* The Pagemaster, *and commercials for Kodak, Listerine, Capri Sun, Mercedes, and Toyota.*

www.teenvoice.com

BRINGING TEEN VOICES TO THE WEB

www.teenvoice.com

by Daniel Jackson

Attracted to the concept of a high-tech publication written for and by teens, I joined the staff of *In-Site*, an online magazine written, edited, and coded by students at my school, the Academy for the Advancement of Science and Technology in Hackensack, New Jersey. Bringing teenage voices to the Web, *In-Site* broke new ground in the online market. As a staff member, I have learned a lot about writing, about online production, and about teenagers like me.

Not just a news source, but a resource for teens that goes beyond the facts, *In-Site* features editorials and reviews, giving young writers the opportunity to express themselves. Topics range from news to fashion, from music censorship to movie reviews, and from sports predictions to computer technology. Besides featuring the perspectives of staff members, the publication also highlights readers' opinions: young people from across the country and around the world post responses or introduce their own ideas on *In-Site*'s response forms and message boards.

In-Site is joined in a partnership with *The Bergen Record*, an area newspaper that helped us get started. The *Record* now sends reporters to our school to assist in teaching writing and journalism classes. *Record* staff also work with student reporters to write and revise articles, gather information, and maintain the Web site.

The *In-Site* staff works in groups dedicated to topic areas, each headed by an upperclassman who directs and coordinates reporters. I worked on many aspects of the publication, including the computer section; the sports section; and "Real Time," which discusses recent news. I also worked independently to write, design, and code feature stories and editorials.

In my feature and editorial writing, I could choose almost any topic. I had fun critiquing the government's attempts to censor music for teenagers and defending Marilyn Manson and Rage Against the Machine for using violent language to express themselves in their own way. My story on this subject was based on a kid who was arrested for wearing an explicit Marilyn Manson t-shirt in a grocery store.

I conducted most of my research for this article by reading *Circus* and *Spin* magazines and by surfing MTV's Web site. Other Web sites are a great source of information, and most will allow you to use their information once you notify them (it is important to quote all sources because of copyright laws). For my article on music censorship, I also conducted a survey at school and compared the results to those of another survey published on the Internet. My purpose was to contrast the views of adults and teenagers on the question of censorship.

The best part about writing freelance for *In-Site* is that the design of the Web page is left completely to the reporter, allowing him or her to integrate graphics and layout, creating a much more powerful article. After writing and checking for grammar, I would code my articles into an HTML template, copying and pasting sections into preset forms of HTML code to make them readable by Internet browsers.

Then, I would work on design, creating graphics from scratch or digitally editing scanned photographs or images provided by *The Bergen Record*, the Associated Press, or other consenting sources. Sometimes students would travel to events and supply us with their own photographs. Once I completed the graphics, I would upload the article to a Silicon Graphics workstation used as the development server, where all articles undergo final adjustments to make sure they work well on a Unix platform. From there they would be moved to the actual server for placement on the site.

In-Site has grown tenfold since its first days, maintaining and strengthening its identity as a teenage publication. I can safely say that my online experience made me more independent, reliable, diligent, and self-motivated. I also enjoyed having an excuse for reading *Spin* magazine and *Rolling Stone* in school—it was research! ■

Daniel Jackson *is a sophomore at AAST, where he is a member of the lacrosse, soccer, and math teams. He and a friend recently started their own Web page design company.*

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Four Friends and a Home Page

by AJ Shankar

Sometimes the activities we pursue just for fun turn out to be the most rewarding. But when AJ Shankar and three of his friends embarked on an experiment in HTML, they didn't expect the awards—or the business opportunity—that would follow.

Near the end of the summer of 1995, my friend Grant came up with the idea of creating a home page for our high school. The Web, only a few years old, was just getting hot, and we wanted to learn more about it. We convinced our friends Dan and Matt to join us in what began as a summer project but eventually turned into an entrepreneurial adventure.

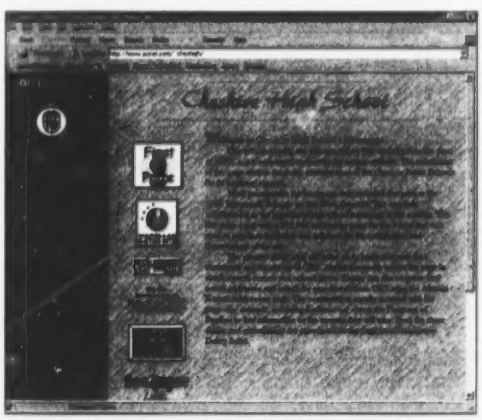
An Award-Winning Hot Site

By the first week of school, we had a prototype of the page to show the head of our school's science department. Both he and the superintendent of schools, who stopped by on that same day, were impressed by what we had done. Encouraged, we refined the site and had it approved by the school administration. In February of the following year, the Cheshire High School page went online.

That was just the beginning of our work. Like any good news source, home pages require constant updating. We decided that our page should be more than just a mission statement and bunch of pictures; we wanted it to be a site people would have a reason to visit regularly. Seeking ways to interest students, alumni, and the community, we posted school events, student accomplishments, the honor roll, and sports results; we even added an alumni registry. And we modified the site design periodically to keep it fresh and up to the latest Web standards.

However, building an audience for a Web site isn't easy. We needed publicity, so we submitted our site's address to *USA Today Online*. In mid-April we received a *USA Today* Hot Site Award, which recognizes "sites that are likely to be sure hits with readers ... by exhibiting excellence in graphics, content or both." *USA Today Online* posted a description of and a link to our site, which dramatically increased our page's popularity. Shortly after winning this award, Cheshire's home page received favorable reviews by local newspapers, RadioONE, and IBM Internet Connection, giving the site exposure to an even wider audience.

When summer came again, we did not rest. Matt and Dan coded Cheshire's entire Program of Studies, more than 250,000 bytes of text. I entered our site in the Microsoft Schools on the Web competition, and all four of us kept the site looking good throughout the summer. Then, in the first week of the new school year, I was called to the principal's office. The site had won first



The Cheshire High School home page (www.pcnet.com/~cheshigh), which displays the various awards it has won, was just the beginning of AJ's work in Web publishing.

prize out of 2,000 schools in the Microsoft competition, crowning it as the premier high school home page in the country. The award came with a $15,000 grant for the school, which we used to purchase a graphics workstation computer so that future Webmasters could maintain the site at school. Our hundreds of hours of work had paid off.

Webmasters for Hire

With college expenses looming, we decided to try to profit from our new skills. During the summer after our senior year we started a company called Team 7 Web Publishing (named after our gym volleyball team). To find customers, we worked with a local public relations agent who was hired by companies to promote their products with print media. With the help of Team 7, he could now offer to build Web sites for these companies. We were contracted to make Web sites for several businesses through this arrangement.

We also did some advertising and mail promotion on our own to attract clients. We even tried selling business-to-business. Doing our own marketing taught us the importance of projecting confidence when dealing with potential customers. We weren't just a bunch of high school kids, we reminded ourselves: we were skilled professionals.

We soon learned, however, that making Web pages professionally is very different from updating a high school home page as a hobby. Deadlines had to be met and specifications had to be carried out to the pixel. Some of the companies we worked with were large—valued at tens of millions of dollars—and had distinct corporate images they wanted to portray. I was in charge of graphics for Team 7, as I was for our high school site, and I found myself spending many hours redoing images until our clients were completely satisfied. In one instance, we redesigned an entire front page—including graphics—five times before the client, a large networking company, accepted it.

Since we were all going off to different colleges, we decided to disband our business at the end of the summer. But we had profited from Team 7 in many ways: we made some money, improved our Web design skills, and gained valuable experience dealing with companies and managing one of our own. I'm now a coder for Harvard's home page (www.harvard.edu), and I think that my time with Team 7 played a significant role in my obtaining this job. Those two summers spent learning and working in Web publishing became so much more than we expected, bringing a school, several businesses, and four students' skills into the cyber age. ■

*A freshman at Harvard University, **AJ Shankar** is planning to major in applied math, computer science track. He enjoys listening to music, playing sports, trivia games, and the trumpet, and (of course) working on his home page at www.fas.harvard.edu/~shankar2/*

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Photo by Michael Gaffney

A Summer Internship at Bell Labs

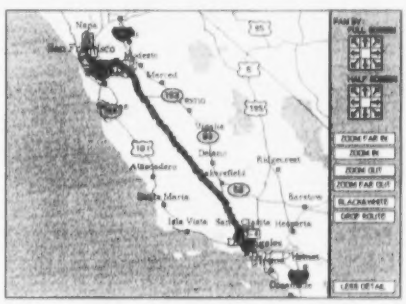
by Scott Aaronson

Internships are a good way to discover how academic knowledge is used in the real world. The right internship can also help you focus your career interests. Last summer, for example, I realized during an internship at Lucent Technologies' Bell Labs that I wanted to pursue a Ph.D. and a career in computer science.

For ten weeks I worked in Bell Labs' Database Systems Research Department as part of the six-member technical team for a Web site called Maps On Us (www.MapsOnUs.com). Maps On Us is a free service that allows users to type in any address in the continental United States and get a zoomable map. For example, the service can find the shortest route from Denver to San Francisco that stops in Wichita and Los Angeles along the way, and can list every McDonald's franchise within five miles of the White House. People use Maps On Us in a variety of ways, from planning road trips to creating directions for party invitations; a prosecutor in Tennessee even used it to prove that a defendant was within driving range of a crime scene.

When I began my internship, Maps On Us had been online for five months, and several new ideas were in the works. We created a new feature called SpeakRoute, which uses Bell Labs' patented text-to-speech synthesizer to read directions aloud. My role was to diagnose problems by testing SpeakRoute with a variety of browsers and operating systems. Once everything was working correctly, this multimedia feature became a favorite with users. In addition, our group made it possible for users to email maps to friends, and I wrote a program to manage the several hundred messages Maps On Us receives every day so that the staff could more easily search and respond to them.

With about a million accesses per day, Maps On Us was already one of the most popular sites on the Web, but we wanted to attract even more users. I was involved in the public-relations effort in two ways. First, I wrote an article about the capabilities of Maps On Us for *WebBound* magazine. Second, at the suggestion of the marketing manager, I designed interactive ads that appeared on Yahoo! and Netscape Guide: users could type the names of two cities directly on the ad and get a route between them. Judging from their click-through rate—the portion of users viewing the ad who click on it—these ads were a success. The rate is typically 3–4 percent for Internet ads, but the rate for these ads reached 17 percent, probably because of their interactive component.



Maps On Us plans routes based on user-entered specifications. This map shows the fastest route from Berkeley to Los Angeles.

Projects like these were only part of what made this internship so rewarding. I especially liked the intense intellectual atmosphere of Bell Labs. People often argue about programming semantics in the dimly lit halls, which are lined by canisters of nitrogen (for the chemistry department) and emergency showers (to rinse your eyes if you squirt toxic chemicals in them). The person sitting at the next table in the cafeteria might be the inventor of the Unix operating system or a Nobel laureate. And, if you're not hungry, you can always visit the nearby chess tables, where the challenge is to find not a partner but an unoccupied table. Bell Labs employees can also attend frequent research seminars on everything from the life-on-Mars debate to nanofabrication with buckytubes. I gave a small seminar myself about a paper I published on hypertext system organization.

If you're considering an internship in software or multimedia, my advice is to look for internships that involve a specific product or research area that you can really sink your teeth into. I chose Maps On Us because it was a tangible service to which I felt I could contribute. If a company's brochure drones on about how it "implements high-end relational object servers for distributed applications in blah, blah, blah," and it sounds boring to you, then it probably is.

Once you've found a few internships you want, apply for them! You might be surprised at how marketable you are, especially if you have strong computer skills. Once you have been accepted somewhere, make sure you know what you will be working on. Your boss might not have time to give you much direction, and if your assignment is not clear you could spend the summer floundering. When I began working at Bell Labs, I undertook to redesign the entire Maps On Us user interface. This project was too ambitious: I would have had to spend months familiarizing myself with the huge base of existing computer code. Luckily, the developers at Maps On Us were a pleasure to work with, and they helped me find projects that were both interesting and achievable within ten weeks.

Since they require a lot of technical creativity but not a lot of background knowledge, internships involving Web site design or multimedia applications are especially suitable for high school students. If you want to spend your summer both learning new skills and applying them to actual problems—and you're willing to work hard—an internship could be an excellent choice. ■

Scott Aaronson spent last year at The Clarkson School, a program that allows high school seniors to live and take courses at Clarkson University. Scott is currently in his first year at Cornell, where he is majoring in computer science. You can contact him at sja8@cornell.edu or visit http://sja8.resnet.cornell.edu

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TUNING IN TO HIGH SCHOOL RADIO

by Jason Weill

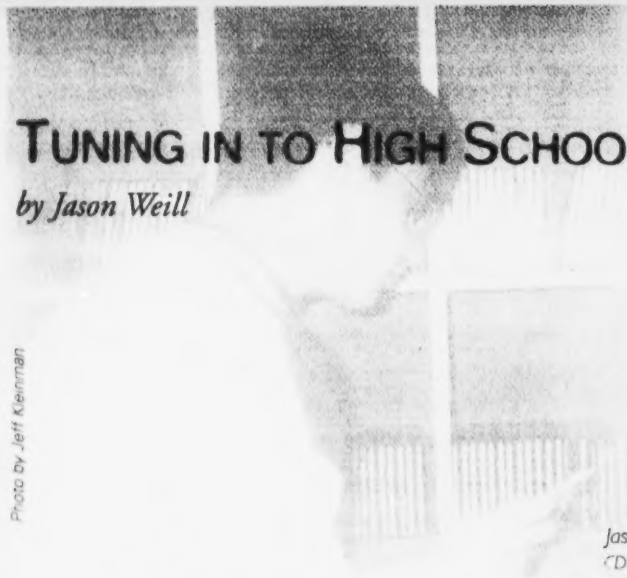

Photo by Jeff Kleinman

Jason chooses from the 7,000 CDs available to DJs at WKWZ.

It's 2:28 on a Saturday afternoon in Syosset, New York. I'm sitting in front of a mixing board, making sure I'm prepared for everything I'll do in the next 100 seconds: Playlist. Check. Weather report. Check. Tapes and announcements. Check.

The second hand completes a revolution.

First two songs cued up. Check. Sign-on announcement. Check. I focus on the clock.

2:29:57, 2:29:58, 2:29:59 ... CLICK. "WKWZ, Syosset," a baritone voice booms across the airwaves. "At this time, WKWZ, Syosset's community radio station, begins another broadcast day." I sit back and relax, but only briefly: in precisely 55 seconds, I'll take the mike and begin a music show.

Before I started working at my high school's radio station, I might have said that radio broadcasting requires little more than flipping switches and playing tracks off CDs. But as I've learned in my three years at WKWZ, radio involves much more.

WKWZ is completely student-run. Students do everything from planning the programs to providing live play-by-play sports coverage, so each one of us has a responsibility that's vital to running the station. If I'm sick, I *have* to find someone to cover my show. It's not possible for a radio station simply to take a day off, and consistently signing off early because the 9:00 p.m. host doesn't show up could result in a lost license. Like all radio stations, WKWZ is regulated by the Federal Communications Commission. Because the FCC requires us to be on the air at specific times, and because we must depend on each other to meet this requirement, our policy is that three missed absences, unless made up by "subbing" for another host, will result in suspension from the station.

It's not enough just to show up, however. As the enormous one-word signs hanging in the station remind us, we have to "THINK" at all times. We have to know and remember the many FCC rules. If someone slips and uses an obscenity, for example, the FCC can fine the station a *minimum* of $7,000, which is more than our annual operating budget. We also have to watch the time, making sure to run our "legal ID"—failure to identify ourselves as "WKWZ Syosset" at the top of every hour could result in a $5,000 fine.

In addition to knowing general FCC rules, we have to keep in mind the specific requirements of individual shows. On a music show, I need to make sure the songs flow together smoothly and to perform quick time calculations to make sure I don't miss a scheduled break. On a sports or news discussion show, one person has to watch the clock and direct the others so that the show covers all the necessary ground in the allotted time. Always remaining alert and prepared requires concentration, and the students who have stayed on at WKWZ have succeeded because they can maintain focus even in hectic situations.

The students' part in keeping WKWZ running smoothly includes raising money to purchase new, state-of-the-art equipment. Although the station receives some funding from the board of education, we have to find ways to supplement our budget. Since commercials aren't allowed on school radio stations, we've experimented with underwriting, convincing local businesses to pay small sums for announcements that read something like, "Portions of this program were brought to you by J. Smith Clothing, located on 400 Elm Street in Woodbury." More often, however, our director of development coordinates special events—such as our upcoming auction of memorabilia from local and national bands—to help us raise money.

But we don't raise money just for WKWZ. We have donated proceeds from races, bowl-a-thons, and other projects to local causes and charities. These events not only raise awareness of and money for the charities, but also strengthen our ties with the community.

Our commitment to the community also shows in our programming. One of WKWZ's most important missions is to broadcast community news, which it has accomplished since its inception 25 years ago. On our public affairs programs, we've covered school board meetings, local elections, and even the local music scene. With our community focus, we have secured interviews with many local people before they hit the national scene: former New York City Mayor Ed Koch, comedians Jerry Seinfeld and Margaret Cho, football players "Jumbo" Elliott and Drew Bleddsoe, and countless musicians. We've also aired interviews with bands that have loyal followings in their hometowns but that get passed over by more mass-market outlets.

One of the biggest rewards of high school radio is that it allows your voice to extend far beyond the walls of your school. Radio combines a slice of fame with a chance to improve your journalism and people skills, to demonstrate commitment and good judgment, and to have a lot of fun. My experience at WKWZ has given me all of this, and I hope to continue broadcasting through college and beyond. ■

Jason Weill, *a junior at Syosset High School, is the publicity director of WKWZ FM. He is currently working on a retrospective program about the 25-year history of the station. You can send Jason email at jweill@northeast.net.*

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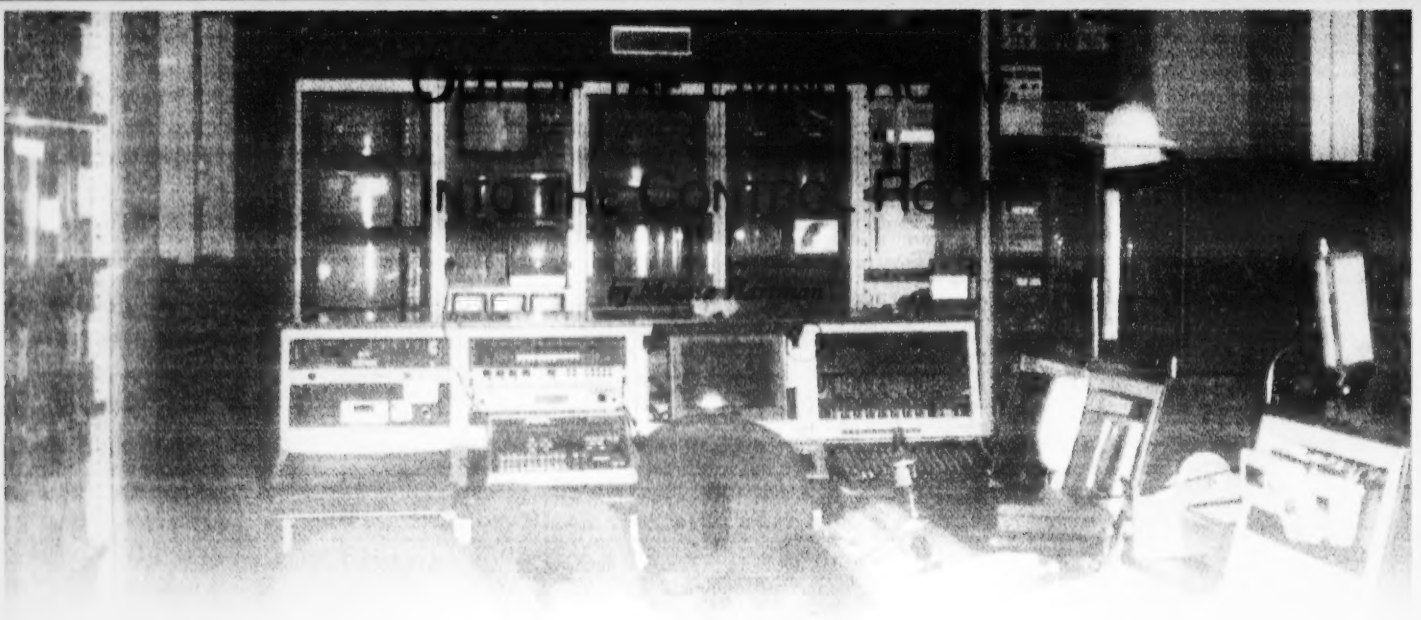


Whether you watch the news every night, *The X-Files* every week, or History Channel documentaries only occasionally, you have seen the product of an extraordinarily collaborative process. Watching a program's closing credits scrolling by, you have probably realized that a television show is the work of many people, most of whom never appear on screen.

It takes a whole team—from camera operator to technical director to film editor—to create a television program. Fortunately, many opportunities exist for you to try your hand at these different production roles. While you might not be calling the shots at CNN or directing an episode of *ER*, you can learn valuable technical skills to take with you to a summer job, to college, and even into a career in television.

School TV

Does your school have a television studio? If it does, you've got a convenient way to start exploring the production process. Some schools offer this opportunity only to students taking a production class, while others allow students to participate as an extracurricular activity. Either way, you can learn how to operate the equipment and help to create programs that might be shown in school or on cable.

For example, at Dundalk High School, a public school in Baltimore, an all-student staff produces three shows that are broadcast on The Education Channel, a local cable channel: *Attic Trax*, a music video program similar to MTV; *What's Goin' On Here*, a show featuring one-on-one interviews with local celebrities and politicians; and *Dundalk High Video Magazine*, a news program that focuses on school and community events. A half-hour each, these programs feature students as hosts, reporters, camera operators, film editors, directors, and producers.

Students at Dundalk High School learn how to operate equipment both on the set and in DHTV's control room.

High school studios like Dundalk's allow students to rotate among jobs on the set and in the control room. Even a very basic studio will give students access to studio cameras, microphones, and lights on the set; and a switcher, a VCR, a video mixer, video monitors, and a sound board in the control room.

But what if your school doesn't have a TV studio? Consider starting a television club. You and other interested students can organize visits to local studios, arrange for guest speakers, and perhaps use equipment from your school's audio/visual department to produce some small projects.

With a lot of work and dedication, your club might be able to establish a studio at your school. Keep in mind, though, that this process may be a long one. After enlisting the support of a faculty advisor and gaining the approval of your school's administration, you may have to organize fund raisers and ask for donated equipment.

Interns Matthew Brown, Freddie Jackson, and Corey Mauzone learn production skills on state-of-the-art equipment.

When all of that is done, you'll need to meet the technical challenges of producing air-quality programs.

Also look beyond your school: you may be fortunate enough to live in the vicinity of a magnet program that offers television production. Intensive coursework and access to high-quality equipment are only part of the benefit of attending these magnet schools: many also offer career shadowing opportunities as well as placement in part-time jobs and internships.

Internships

Even if you don't attend a magnet school, you can take advantage of internship opportunities in your community. While many internships—even in public television and at local stations—are given only to college students, some small stations, especially cable stations, offer internships to high school students.

One major advantage of working at these smaller stations is that you can gain experience in many different production roles. Just ask high school students Corey Mauzone, Matthew Brown, and Freddie Jackson, all interns at Baltimore County's Education Channel. "We're learning how an actual TV station runs, even though it's small," Freddie explains. "And because it's small, it's easy for us to rotate into different positions."

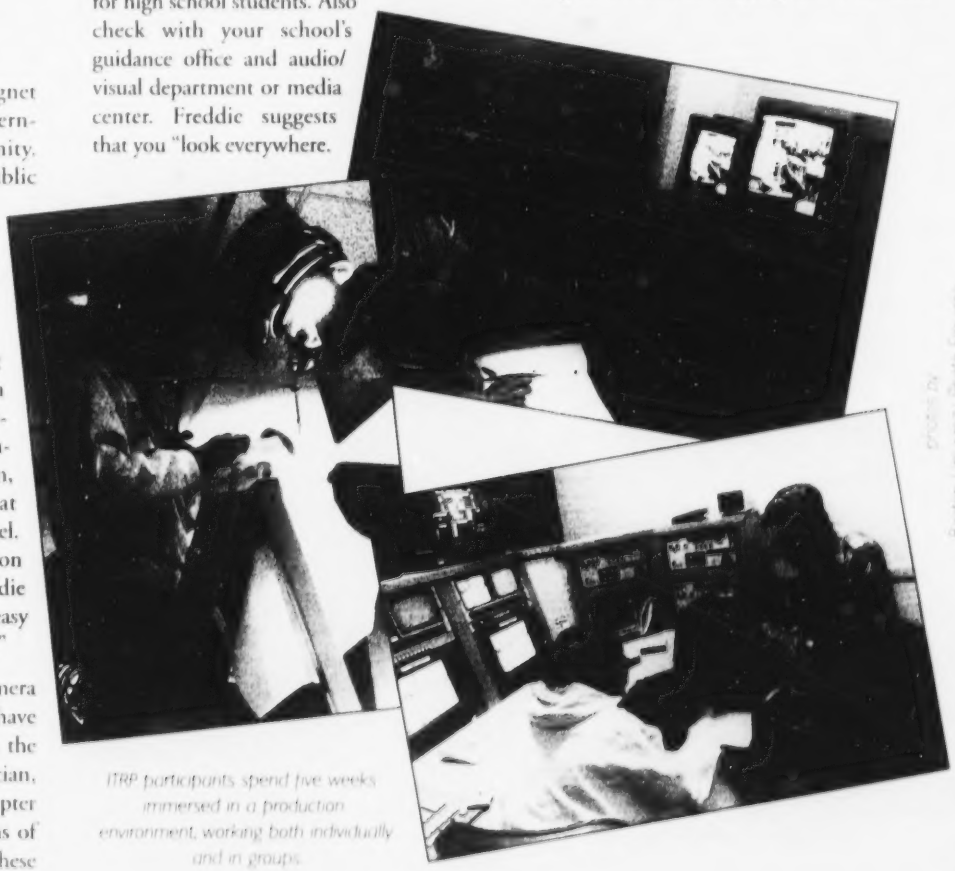
All three students have worked as camera operator and stage manager, and they have begun to explore different positions in the control room, acting as audio technician, character generator operator, teleprompter operator, and even director for portions of some shows. They learn the skills for these positions from professionals on state-of-the-art equipment. And they can practice what they've learned when they're not working: "We can use the equipment here any time we want to, and we can sign some of it out to take home. That's one of the best things about interning."

If you want to find an internship like this one, start with the phone book—call your local television stations as well as your cable provider and ask about opportunities for high school students. Also check with your school's guidance office and audio/visual department or media center. Freddie suggests that you "look everywhere. The opportunities are out there—you just have to call around. It's harder at bigger studios, but there are small stations that give high school students a chance."

Summer Programs

Another great way to learn about production is to attend a summer program. If you have no production experience, a summer program can introduce you to the field and help you decide if it's something you'd like to pursue during the school year. If you already have a production background, a summer program can help you hone your skills as well as develop new ones.

As with programs in other disciplines, summer programs in television and film vary in length and intensity. Students looking for an overview might prefer The Media



ITRP participants spend five weeks immersed in a production environment, working both individually and in groups.

Continued on next page

Continued from page 11

Workshops, one-week sessions held at UCLA that include visits to major motion picture studios and network production centers. Students desiring a more in-depth study would probably benefit more from the longer programs offered by the Pre-College Summer Institute, the Institute for Television, Film, and Radio Production, or the National High School Institute. Participants in these programs combine what they learn in hands-on exercises, workshops, and lectures to create finished portfolio pieces.

Looking Ahead

Summer programs, internships, and school studio experience can help you make important college and career decisions. If you think you want to pursue a career in television, look for colleges that offer a major in television or film studies. You'll also want to find a school that provides internship opportunities so that you will have experience when you're searching for a job in this competitive industry.

Involvement in production while you're still in high school can also make a difference when you apply to college. While some excellent undergraduate programs in television/film, such as those at Northwestern University and Columbia University, do not require separate applications or previous experience, others do. Both The Film School at Florida State University and The School of Cinema-Television at the University of Southern California require a separate application; USC's program also requires a portfolio, and FSU's program weighs previous filmmaking experience and studies in their admissions process. Applicants to many arts colleges, such as The University of the Arts in Philadelphia and The California Institute of the Arts, can expect to appear in person for a portfolio review.

Clearly, your high school production experience will be helpful to you if you're planning to major in or pursue a career in television or film. Even if you're not, you can learn a lot from the production environment—about teamwork, about media technology, and about the satisfaction of creating a product for others to view and enjoy. So the next time you're watching your favorite show, remember you are seeing only the outcome of a complex process—a process you can learn, and learn from. ■

Whose Job Is It, Anyway?

These descriptions will give you an idea of what role each member of the production team plays. Of course, responsibilities for production positions depend upon the size of the production and vary among studios.

Producer: The leader of the production team, the producer supervises the entire production process, from planning the budget to hiring other members of the team. In small studios, the producer might also assume the role of director.

Director: The director has responsibilities at all stages in production. He or she arranges the positions of cameras and talent (the people who appear in front of the camera) during preproduction, then selects the camera shots during production. Finally, the director supervises post-production work, such as film editing.

Technical Director: The technical director works in the control room. In addition to operating the switcher (the equipment that switches from one camera to another), this person supervises audio, video, effects, and all other technical aspects of the production.

Audio Director: Also called the audio technician, this person sets up and checks the microphones, and monitors sound quality throughout the production.

Videotape Recorder Operator: In a role similar to that of the audio director, the VTRO performs recording checks and monitors video quality.

Electronic Character Generator Operator: The CG operator designs and types in the closing credits you see at the end of a movie or television show as well as any opening titles and subtitles.

Teleprompter Operator: Integral to the production of live broadcasts, the teleprompter operator makes certain that the script flows properly for the talent to read. In rehearsals, the teleprompter operator may also make changes to the script as specified by the director.

Camera Operators: In addition to performing the actual shooting of a production, camera operators set up, inspect, and maintain the cameras. They may also work with the director in deciding on shots.

Stage Manager: This person coordinates the activities of all of the people who work on the set, including camera operators and talent. The stage manager, with help from stagehands, is also responsible for putting together and breaking down the set.

Editor: Film editors receive the raw tape and may cut segments, arrange segments in a different order, make adjustments in sound or lighting, and add special effects.

For more information about the summer programs mentioned in this article:

Institute for Television, Film, and Radio Production

Boston University
College of Communication
640 Commonwealth Avenue
Boston, MA 02215-2422
(617) 353-5015
itrp@bu.edu
www.bu.edu/COM/itrp

The Media Workshops Foundation

291 S. La Cienega Boulevard, Suite 735
Beverly Hills, CA 90211-3312
(800) 223-4561
mworkshop1@aol.com

National High School Institute

Radio/TV/Film Division
Northwestern University
617 Noyes Street
Evanston, IL 60208-3026
(800) 662-NHSI
nhsi@nwu.edu
www.nwu.edu/nhsi/rtvf.html

Pre-College Summer Institute

The University of the Arts
320 South Broad Street
Philadelphia, PA 19102-4901
(215) 875-3355
(800) 616-ARTS (outside PA)
pcuarts@netaxs.com

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EDUCATION AT A DISTANCE

From traditional intellectual mentorships via correspondence, to CD-ROM-based courses, to interactive virtual classrooms hovering on the Web, distance education is transforming the way we learn. Read on to discover how you can benefit from these countless opportunities.

Do you want to take more advanced courses than those your school offers? Do you yearn to become better versed in literature or to strengthen your writing? Are you ready for college courses but not ready to leave high school to enroll full-time in college? Distance education is one of the most powerful resources at your fingertips if you are ready to expand, deepen, or accelerate your education.

A top-notch distance learning experience replicates the elements of a good classroom experience: curricular materials crafted from a comprehensive knowledge base; intensive contact with an excellent teacher; built-in, periodic assessment to ensure an appropriate degree of academic challenge; and, in some cases, student community facilitated by email.

Learning at a distance also offers unique benefits: Whether you live in New Mexico or Alaska, you can touch down on a virtual campus with the flick of a switch. You don't have to board a plane or catch a bus to take advantage of distance education.

And you don't have to set an alarm clock. Some programs, such as CD-ROM-based courses without a person-to-person tutorial, impose no time constraints; more complex programs mandate scheduled assessment and tutorial feedback, but leave students free to work when they please. Considering the demands of swim practice, theater tryouts, and family activities, some learners judge the freedom to schedule their own learning to be distance education's greatest benefit.

And then there are the educational benefits. Multimedia software, such as CD-ROMs, combined with Internet connections, can open up a whole world of knowledge: a single CD may contain an entire course, integrating images, animation, video, sound, and links to Web resources. Multimedia courseware can also accommodate differences in learning styles. Some learners benefit from visual or aural cues that reinforce material and instructions. And the freedom to navigate a lesson in one's own way—slowly, for example, or over and over again—can strengthen any learner's grasp of new concepts and skills.

Distance education works best for committed learners with time and resources to devote to additional study. So take a look—at yourself—before you leap.

Are you a self-starter? To get the most out of distance learning, you need to be intellectually curious, motivated, and disciplined enough to work consistently on your own. The tendency to procrastinate is natural in most of us; it's how you handle that tendency that makes the difference.

Do you have time? Most academically talented students are already heavily engaged in school and activities. If you are considering a distance education program to supplement your learning, ask yourself one important question: Can you realistically fit extra work into your daily schedule, or are you likely to fall behind, become frustrated, and lose interest?

Can you afford it? At the most basic level, you need to consider the cost of tuition and textbooks/materials. Traditional by-mail correspondence courses may be very reasonable, but high-tech transmission requires sophisticated computer equipment and online time. Having your own system is most convenient, of course, but may not yet be an option for your family.

Once you've considered these questions, if you still want to become a distance learner, all you have to do is decide what kind of program in what subject you want, as well as what kind of delivery system will work best for you. To find a program that accommodates your educational goals, start with the list of distance learning options on the following pages. ■

Distance education programs, such as IAAY's Math Tutorials, allow you to enjoy the benefits of a classroom experience at home.

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SELECTED DISTANCE LEARNING OPTIONS

IAAY'S DISTANCE LEARNING PROGRAMS

Now—without leaving home—students can receive the individualized instruction that is the hallmark of IAAY's programs. The Center for Distance Education offers flexible, self-paced courses in writing and mathematics. Integrating sound pedagogy, solid curricula, and expert, responsive tutors, this program strives to create a community of learners who share common intellectual bonds.

IAAY Math Tutorials

The Math Tutorials are a series of mathematics courses for qualified students in grades K–12. These courses, which range from primary school- to college-level, are offered in a multimedia IBM-compatible format. Students work at their own pace and consult with their tutors on a regular basis. Tutors provide feedback based on weekly reports turned in by their students.

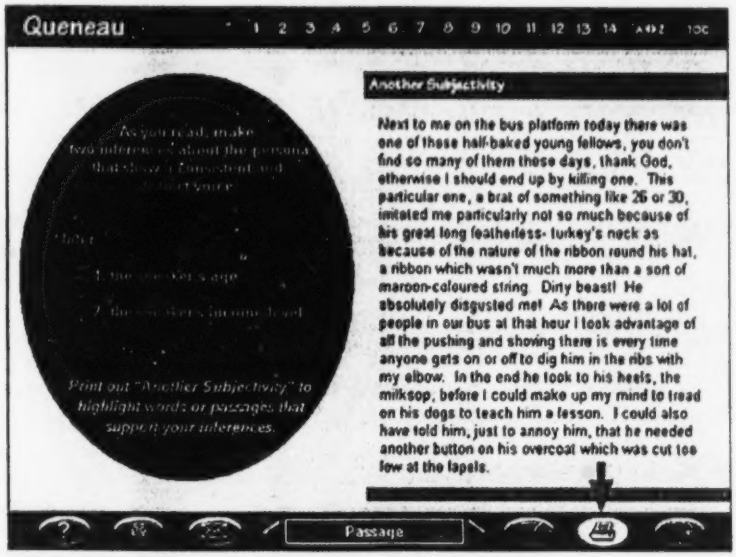
Students establish eligibility by earning a qualifying score in an IAAY Talent Search. K–1 students qualify based on recommendations and above-grade-level scores on a quantitative analysis or mathematical achievement test.

Application deadlines: Tutorials begin on the first of each month. Students should send their applications five weeks in advance of the date they would like to begin.

IAAY Math Tutorials
The Johns Hopkins University
3400 North Charles Street
Baltimore, MD 21218-2699
(410) 516-4759, fax (410) 516-0200
math.tutorials@jhu.edu
www.jhu.edu/gifted/cde

IAAY Writing Tutorials

The Center for Distance Education's Writing Tutorials offer courses for students in grades 6–12. Beginning with invention techniques and moving through rhetorical modes of exposition, description, analysis, argumentation, and persuasion, students can participate in a full writing experience that culminates in courses in poetry, fiction, or AP Composition.


Queneau
Another Subjectivity
Next to me on the bus platform today there was one of those half-baked young fellows, you don't find so many of them these days, thank God, otherwise I should end up by killing one. This particular one, a brat of something like 26 or 30, irritated me particularly not so much because of his great long featherless- turkey's neck as because of the nature of the ribbon round his hat, a ribbon which wasn't much more than a sort of maroon-coloured string. Dirty beast! He absolutely disgusted me! As there were a lot of people in our bus at that hour I took advantage of all the pushing and shoving there is every time anyone gets on or off to dig him in the ribs with my elbow. In the end he took to his heels, the milksop, before I could make up my mind to tread on his dogs to teach him a lesson. I could also have told him, just to annoy him, that he needed another button on his overcoat which was cut too low at the lapels.
Print out "Another Subjectivity" to highlight words or passages that support your inferences.
Passage

IAAY's CD-ROM version of Crafting the Essay combines sound and visuals in a series of short exercises that make up fourteen lessons.

Designed by veteran writing instructors from IAAY's summer programs, courses are geared to the highly motivated writer. During the academic year, a student completes fourteen assignments and receives comprehensive feedback from his or her tutor. In all courses, a heavy emphasis is placed on the writing process: prewriting, drafting, and revision.

Writing courses are conducted via surface mail or email. A multimedia CD-ROM version of Crafting the Essay will be available this fall.

Application Deadline: August 29, 1998.

IAAY Writing Tutorials
The Johns Hopkins University
3400 North Charles Street
Baltimore, MD 21218-2699
(410) 516-0277, fax (410) 516-0200
IAAY.EWTinfo@jhu.edu or
IAAY.YWTinfo@jhu.edu
www.jhu.edu/gifted/cde

ADDITIONAL DISTANCE LEARNING OPTIONS

LetterLinks

Through LetterLinks, students in grades 6–12 may take high school honors-level courses in mathematics, science, social sciences, and the humanities by mail or email. For the duration of each course (about nine months), you and your tutor—a high school teacher experienced in working with academically talented students—correspond on a regular basis.

LetterLinks also offers two computer-based learning programs: WordTeacher, a vocabulary-building program; and math courses on CD-ROM, developed by EPGY.

Eligibility is based on your scores on SAT/ACT exams taken in grades 6–8.

LetterLinks courses begin twice a year.

Next registration deadline: September 15, 1998.

LetterLinks
Center for Talent Development
617 Dartmouth Place
Evanston, IL 60208-4175
(847) 491-3782, fax (847) 467-4283
jar@nwu.edu
www.ctd.nwu.edu

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Duke University TIP

Duke University's Talent Identification Program offers three distance learning opportunities: The Learn On Your Own Program, which allows students to work with a mentor of their choice to master materials designed by TIP; Talent On-line, which offers mathematics courses through a TIP partnership with EPGY; and the Graphics Calculator Project, which uses the TI-83 graphics calculator as a tool for analysis and mathematical modeling in mathematics and science coursework.

Registration deadline:
Open enrollment

Duke University/Talent Identification Program (TIP)
P.O. Box 90747
Durham, NC 27708-0747
(919) 684-3847
www.tip.duke.edu

Merlyn's Pen Mentors in Writing Program

This twelve-week, noncredit program for students in grades 6–12 requires no qualifying scores or academic grades and is intended to supplement, not replace, school courses.

Your mentor—a professional writer or editor on the *Merlyn's Pen* staff—sends you personalized assignments, written critiques, and suggestions for revision. Upon successful completion of the semester, you receive a written evaluation from your mentor, along with a Certificate of Achievement in Writing.

The Mentors in Writing Program offers both a three-month and a six-month program. The number of assignments and responses is the same for both programs.

Application deadlines:
July 1 for the three-month program;
October 1 for the six-month program.

Merlyn's Pen Mentors in Writing Program
P.O. Box 1058
East Greenwich, RI 02818-0964
(800) 247-2027
merlynspen@aol.com
www.merlynspen.com

Gelfand Outreach Program in Mathematics

The Gelfand Outreach Program in Mathematics at Rutgers University encourages the development of mathematical ability by using non-standard problem-solving models in algebra, geometry, analytical geometry, and precalculus.

After completing a diagnostic assignment, you work either individually or in groups to complete monthly assignments. The solutions and explanations you submit are reviewed and commented on by faculty members and graduate students in the Department of Mathematics. You receive a certificate for the successful completion of each year/level of the program.

Registration deadline:
Students may enroll at any time during the school year.

Center for Mathematics, Science, and Computer Education
118 Frelinghuysen Road
Piscataway, NJ 08854-8019
(732) 445-3491, fax (732) 445-3477
gopm@math.rutgers.edu

Penn State Independent Learning Program

Penn State uses both traditional and nontraditional methods to bring any subject offered through its colleges directly to you. An academic advisor is available to assist you in choosing from over 300 credit and noncredit courses. Your assigned instructor communicates with you by mail and telephone.

Independent Learning Program
The Pennsylvania State University
207 Mitchell Building
University Park, PA 16802-3601
(800) 252-3592
psude@cde.psu.edu

Texas Tech Guided Study

The Texas Tech University High School offers a complete state-accredited diploma curriculum as well as undergraduate courses from six colleges of this major research university.

Guided Study
Texas Tech University
Box 42191
Lubbock, TX 79409-2191
(800) MY-COURS
www.dce.ttu.edu/

University of Nebraska–Lincoln Independent Study High School

This program offers four online courses (with six more to be added in August) and 125 print-based courses. Students can take either the college prep track or general studies track to earn a fully accredited diploma. UNL also offers high school students approximately 80 print-based college-level courses for college credit.

University of Nebraska
Independent Study High School
Department of Distance Education
Division of Continuing Studies
Clifford Hardin Nebraska Center for Continuing Education, Room 269
33rd and Holdredge Streets
Lincoln, NE 68583-9800
(402) 472-4321, fax (402) 472-1901
unldde@unl.edu
www.unl.edu/conted/disted/index.html

University of California Extension

Through this extensive program, you may correspond with your instructor for high school, university, and professional development courses by mail, email, or fax. Some courses may now be taken via America Online and on the Internet.

Center for Media and Independent Learning
University of California Extension
2000 Center Street, Suite 400
Berkeley, CA 94704
(510) 642-4124
cmil@violet.berkeley.edu

University of Wisconsin Extension

You may choose from hundreds of high school and university correspondence courses and enroll at any time during the year. Keeping in touch with your assigned instructor by mail or email, you work at your own pace, taking up to twelve months to complete coursework and exams.

UW-Extension
Independent Learning
104 Extension Building
432 North Lake Street
Madison, WI 53706-1498
(800) 442-6460, fax (608) 262-4096
ILEARN@ADMIN.UWEX.EDU

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W[illegible] IN THE WINGS

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[illegible] Mackay

Black-and-white shots of young women ... interviews filmed 50 years later of women in their seventies ... photographs of the industrial city of Pittsburgh in the 1940s ... "Heinz 57" employee newsletters ... government movies urging women to join "the homefront army" ... D-day footage showing the sky over France blackened with American aircraft and parachutists.

Out of these materials, Julia Love, 17, crafted *Women in the Wings: Pittsburgh's World War II Workers*, a 30-minute documentary released this spring. America's D-day invasion of German-held French territory during World War II was accomplished in part by glider pilots who braved enemy fire to transport men and equipment, including Jeeps, into France. Julia's film focuses on a domestic secret behind the invasion: wings for America's glider planes had been painstakingly built by hundreds of female workers in a Pittsburgh processed food plant.

Researching, directing, writing, editing, narrating, and producing her documentary took Julia over three years. Despite setbacks, such as being turned down for funding because of her age, she remained true to her goal. "What motivated me all along," says Julia, "was wanting to make a tribute to the women who made the gliders."

"It started with my history teacher, Susan Schotz Rhodes. Once, out driving, she tailed a man who had a bumper sticker on his car that read, 'World War II Glider Pilots' 50th Reunion.'" In a parking lot, Mrs. Rhodes invited Ed McCague to give a talk about his wartime experience to her students at Pittsburgh's Shady Side Academy.

Then in ninth grade, Julia learned a great deal about World War II from the ex-glider pilot's presentation. His story included a surprising piece of local history: Pittsburgh women had been recruited by the H.J. Heinz Company to build military glider wings in a Heinz building, using plywood normally used to make the food company's crates and boxes. Encouraged by Mrs. Rhodes, Julia started to ask questions. "But no one seemed to know about the glider-making, not even my grandparents, who have lived in Pittsburgh all their lives." The conversion of the Heinz plant into a war materials factory had been top-secret—

"the fear was that if the Nazis found out, they would bomb it," Julia explains. "At the time, people were not allowed to talk about their jobs, and many of them have been silent until recently. The story was untold."

Julia decided to tell the story through the medium of film. "My dad is a producer, and I had been a production assistant for him before," she notes. (Julia's father and a colleague taped the film's interviews, under Julia's direction.) "But mostly I chose film because it was the best way to preserve interviews of the women. They're getting older now—they're all in their seventies." Through film, Julia could create a permanent visual memory of her subjects.

First, she had to find them. "I contacted the Heinz company for employment records, but they had been destroyed. So Mrs. Rhodes and I drove around Pittsburgh, posting flyers in churches and senior citizen centers, asking the women workers to call." For a long time nothing happened. And then something did: "Almost a year later, Big Jean called our school. When Mrs. Rhodes and I went to interview her, she was wearing red cowboy boots, with her fingernails painted to match her sweater. She was animated about her life and remembered a lot about working at the Heinz plant. We knew then that we had a film."

Julia eventually interviewed five women for *Women in the Wings*. "I was 21 years old, and my husband had been drafted," Big Jean testifies. "We were married in March, he was drafted in April, and he went off to the war." Like others back home, she explains, she began to look "for ways and means of surviving." Her search led her to the Heinz plant.

Of Young Women—Past and Present

By following contemporary interviews with old photos and wartime footage, *Women in the Wings* transports its viewers from the present to the past. Julia herself suggests the trip back: today, she is almost the age that her subjects were when they worked in the factory. "I think that the women were so open with me in part because I was even younger than they were during the war," she says.

The Pittsburgh women themselves led diverse lives, and Julia began to put her film together only when she was sure it would speak in a range of voices. After others had already been interviewed, Julia made special appeals on radio and in the *Pittsburgh Post-Gazette*, hoping to hear from African Americans who had been part of the glider-making. Eventually, Kathryn Nolan called to add her testimony: how she had been

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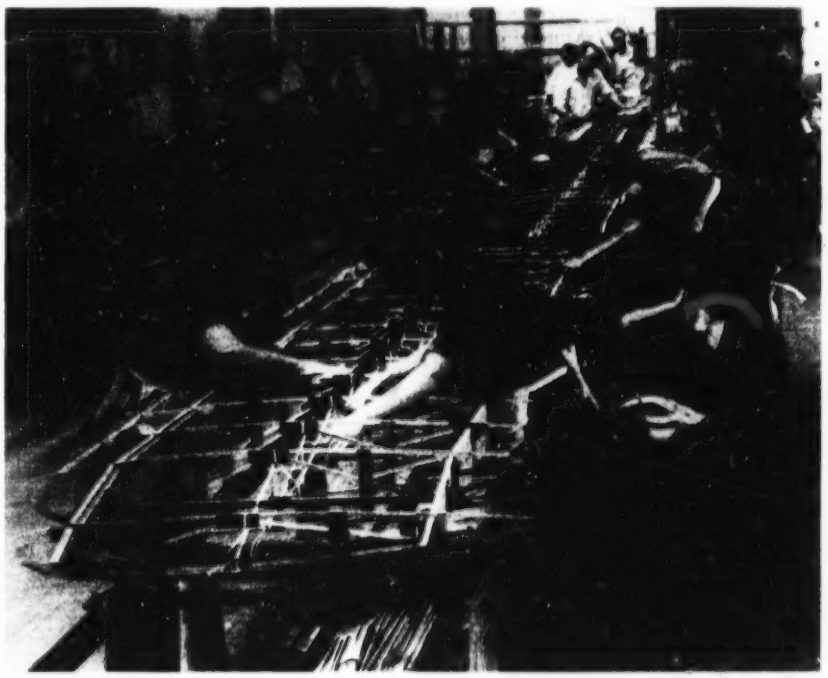
rejected from art school because of her race; how she came to the factory to escape having to work in domestic service; how her boyfriend had been a soldier and she had wanted to contribute to the war effort; how she grew to enjoy taping and gluing and nailing the long glider wings, as well as the camaraderie in the plant. "I really believe that common cause was the true meaning of what we did," she attests in the film.

Kathryn Nolan died in the summer of 1997, before seeing herself on film. Her family attended the Pittsburgh première of *Women in the Wings*. "The film preserved the memory of her," says Julia. "I was happy to have been able to do that."



What Is a Glider

What were the special aircraft that Kathryn Nolan and the other women built for almost two years? Gliders are designed to imitate the flight of soaring birds. Their technology is relatively simple, a function mostly of aerodynamic shape—tapered wings and a lightweight body made from wood, metal, or plastic—as well as simple mechanical devices—a steering wheel, a rudder operated by foot pedals, a variometer to measure rates of ascent and descent. Gliders have been used mostly for sport and for meteorological research.

In 1940, the Germans used gliders to invade Belgium. After that, the British and the Americans began to use large gliders to transport troops and equipment in the preliminary stages of an invasion. Towed and then released by small transport planes, the gliders would silently soar toward enemy territory, kept afloat by rising air, thermal currents, and clouds.

While *Women in the Wings* focuses on the workers who made the gliders, it also reveals the experience of the pilots who flew the engineless aircraft during the D-day invasion. Ed McCague, the man Mrs. Rhodes had followed into a parking lot, adds moments of intense emotion to Julia's film, recalling the experience of navigating a descending glider through heavy fire. "It was just something indescribably awful, in my opinion," he says, looking straight into the camera. Mr. McCague's moving testimony is accompanied by war footage of American gliders forced into violent crash-landings.

Making a Film ... and Winning Support

The abundance of voices, diversity of materials, and shifting time-frames of *Women in the Wings* makes the documentary something of a collage. Julia and her editor, Henry Simonds, a recent graduate of Middlebury College, needed to organize the interviews, other footage, and still images Julia had gathered and to compose a narrative that would unify them. "We just sat and tried to fit the story together," Julia says. "We organized all the topics on a big board. It was exciting because Henry and I had complete control of the script."

The excitement of piecing together the film sustained Julia even when she couldn't convince others to support her project. "From the first year," she explains, "I started trying to raise money, but I only got rejection letters. The foundations didn't think that I would finish the film, or they didn't think that it would be of professional quality. I just went on with my work, conducting the interviews and putting the film together as much as I could. Toward the end, though, I really needed money for the sound mix and for the final editing. So I had a meeting at the Heinz Company Foundation and showed them a rough cut. They gave me money, and then I got more from other foundations."

Other times, support came quickly. President Bush, a pilot who had been shot down in World War II, taped an introduction for *Women in the Wings* just days after Julia sent him a copy. "I didn't expect to hear from him, but I got a tape back in a week. I called everyone I knew, and then I ran all over town looking for a machine that could play a professional videotape. When I found one, I played his introduction over and over."

Convincing a President to introduce her film was an amazing achievement. However, for Julia, even that honor could not outshine an earlier triumph: "The best part of making the film," she says, "was when Big Jean called and we went to meet her." ■

*Women in the Wings has premiered in Pittsburgh and Los Angeles and at the Schlesinger Library of Radcliffe College. This fall, **Julia Love** will attend Duke University. She is currently helping her father with his next film.*

Still Life with Movement
Video as Art

by Ted Winstead

With its plush wall-to-wall carpet, the room could almost be in your house. A wooden chest stands alone against the back wall. A vase of flowers, a short table lamp, and a compact digital clock showing real time have been arranged atop the chest. The room is unremarkable but for a small black-and-white monitor on the chest displaying the face of a middle-aged woman sleeping.

A minute passes, and the woman adjusts her head against the pillow. Then, without warning, the lamp shuts off, and floor-to-ceiling video images appear on three walls. An agitated white owl, filmed close-up at night, flies at the viewer. Loud industrial sounds come from speakers in the ceiling. After a few seconds, the room abruptly returns to normal—the lamp switches on, and the sleeping woman reappears on the monitor.

Bursts of sound and video continue to jolt the room at random intervals, a disconcerting flurry of incoherent sounds and chaotic images—lunging Dobermans, burning buildings. The sleeping woman and the dramatic transformations of the room seem to suggest the mind, with its capacity for wakefulness, sleep, and the heightened realism of dream states.

Media as Art: Video and Oil Paints

This is not a room in your house. It is art, a 1988 video/sound installation called *The Sleep of Reason* created by California-based artist Bill Viola. A retrospective of Viola's work in video occupied two floors of the Whitney Museum of American Art in New York this spring. On a different floor is a popular work from the museum's permanent collection, *Early Sunday Morning*, a 1930 painting by the American artist Edward Hopper. The oil painting depicts a series of storefronts in a small town, as seen from the street in late afternoon sun.

You could visit both works of art in an afternoon. The Hopper painting hangs on a white wall, displayed prominently in a quiet, well-lit room with other paintings. The environment seems perfect for contemplating the muted greens and reds of the two-story buildings and the long shadow from a barber's pole in the foreground. If you went upstairs to the Viola exhibit and came back two hours later, the painting would not have moved, and the room's lighting would be the same. Only the group of people around you might be different.

Bill Viola, The Sleep of Reason, *1988*
Courtesy of the Whitney Museum of American Art.
Photograph by Kira Perov.

Meanwhile, *The Sleep of Reason* continues to alternate its environments. You could stay for fifteen minutes or so, and a different video clip with its own audio would appear at each interval. But to experience the entire work, you would have to stay for a complete cycle, and there is no way to know up front how long that might take.

We encounter these works of art in very different ways, but ultimately the dissimilar media of oil paints and video technology can accomplish the same thing: they can stir in us responses beyond that of recognition. We react to the media as art. In contrast, we perceive much of the visual stimuli of everyday life, such as traffic lights, merely as information.

The Portapak: A New Technology

Before 1965, only television stations worked in video because the technology necessitated well-lit studios and teams of engineers to operate the heavy equipment. But that year Sony introduced the original portable video camera and recorder, the Portapak. Although cumbersome—a bulky camera, open-reel recording deck, and battery pack—the Portapak could record in relatively low natural light, allowing for spontaneous recording almost anywhere.

Video art has taken many forms since artists began experimenting with video technology in the late 1960s. In video sculpture, artists use TVs and video monitors to create three-dimensional works of art, such as the figure of a person constructed from 1950s TV consoles. A video installation—like *The Sleep of Reason*—is an environment that incorporates video technology.

Today, any work that utilizes television or video technology is considered video art. The scope of the field limits the depth of any introduction to video art, but we can sample the diverse body of works by examining the medium's distinct features.

New Representations of Time and Space

Many video artists exploit the medium's capacity to represent time and space in ways not possible before video. Consider the complexities of time and space in *The Sleep of Reason*: The video clips were filmed in real time at some point in the past. They appear at unpredictable intervals, breaking up the present with startling images from some previous time, leaving the impression, at least for a moment, that past *is* present.

143

The video images also provide a direct connection to some other location, or space.

As for the sleeping woman, she may be on videotape, or she may actually be sleeping in another place and appear on the monitor as part of a live hook-up. The latter scenario is impractical but possible, and live pictures are common in video art. Either way, the room is connected to another space via the monitor. An element of future time is involved, too, as you instinctively try to anticipate each jolt of image and sound. Finally, the passage of time is marked by the compact digital clock on the chest.

Taking on Television

Another of video's distinct properties is a unique ability to represent television. A defining feature of modern life, television can be a compelling subject for any artist, but particularly for video artists. In Viola's words, video enables us "to speak directly in the language of our time"—the language of television.

Nam June Paik, Video Flag, *1985-1996*
Courtesy of Hirshhorn Museum and Sculpture Garden, Smithsonian Institution, Holenia Trust Fund, 1996
Photograph by Lee Stalsworth/Ricardo Blanc

There is a historical connection between video and television as well. In the late 1960s when artists began experimenting with video, television played a decisive role in shaping public opinion regarding the war in Vietnam. Support for the war diminished sharply after the networks began broadcasting daily body counts and combat footage of U.S. troops on the nightly news. Early video artists were fascinated by this powerful medium, and video artists have glorified, analyzed, and criticized television in their work ever since.

One example of artists taking on television is a July 4, 1975, event staged and videotaped by a group of San Francisco video artists that drew 500 people and was covered by local TV crews. The focus of the event was an elaborate speech in which a man made up as John F. Kennedy critiqued corporate capitalism and television. Later, an artist drove a Cadillac through a wall of old TVs. (The vehicle had been modified to withstand a high-speed crash.) That night the artists taped local TV newscasts, all of which highlighted the crash and ignored the speech. Combining performance art (the crash and the speech) with its TV coverage, the artists created a video documenting what they saw as television's bias toward sensationalism.

Familiar Subjects, with a Twist

The video camera can also function essentially as a high-tech paintbrush, using its distinct properties to convey familiar subject matter in unfamiliar ways. A stunning example of this is Nam June Paik's installation *Video Flag*, on exhibit at the Hirshhorn Museum in Washington, D.C. The seven-by-twelve-foot bank of 70 thirteen-inch monitors is immediately recognizable as an American flag. Its electronic stars and stripes merge with split-second news stills, endless runs of ones and zeros, and the morphing faces of every U.S. president from Truman to Clinton, which appear in place of stars.

Images fly by. Among them we see photographs of Vietnam protesters burning the American flag. By including these stills, Paik honors those who once rejected—in the most defiant way possible—the very icon he recreates. In *Video Flag* we immediately see a fresh interpretation of a classic symbol of patriotism. But it is also an ironic meditation on the meaning of patriotism, made possible by video technology.

The future of video art is wide-open. Judging from recent newspaper articles on video art and from the success of the Viola retrospective, the medium seems healthy and vibrant. Video will surely be combined with new computer-based media in the years to come, creating endless possibilities for artists.

STATES OF THE ART

The Past

The story of video art, according to lore, begins at the Liberty Music Store in Manhattan in 1965, when a Korean-born artist named Nam June Paik purchased a Sony Portapak that had been part of the first shipment to this country from Japan. On his way home, Paik shot scenes of the Pope's visit to New York, and that night he played the videotape [illegible] group of artists. A spontaneous documentary with an artist's sensibility, the videotape is considered by many the first work of video art. Today Paik is frequently referred to as "the father of video art."

The Present

Female artists have been drawn to video in part because it has little history or established bureaucracy. The diverse work of today's female artists is notable for its subjects and innovative points of view. For example, Johnna MacArthur's 1996 *Chalk Confessions* is an intimate and improvisational work in which the viewer engages in someone else's personal ritual. The video shows a close-up of a hand scrawling private thoughts on a small slate in chalk and then crossing them out.

After years of being relegated to out-of-the-way corners of museums, video seems to have achieved parity with other media in the eyes of the art establishment. On the occasion of the Viola retrospective, the *New York Times* declared that "video has become an unavoidable, if not ubiquitous, fact of art-world life." Recent international exhibitions like the Venice Biennale have showcased video art, and major museums like the San Francisco Museum of Modern Art are acquiring it for their permanent collections.

The Future

When the Guggenheim Museum in New York throws a party for the millennium, video will be there. Paik is one of two video artists with shows slated for the millennium. His exhibit will feature the installation *Megatron/Matrix*, which is similar to *Video Flag*. This time, a wall of 215 monitors will display sequences that include documentary images, national flags, and even giant birds that migrate across the screens.

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Exploring Career Options: Immunology

Interview with James Hildreth

by Carol Blackburn

James Hildreth, M.D., Ph.D., divides his time between two jobs: As Associate Professor of Pharmacology & Molecular Sciences, he studies the immune system's capacity to fight HIV, while as Associate Dean for Graduate Studies at The Johns Hopkins School of Medicine, he nurtures a new generation of biomedical scientists.

How did your interest in the world of medicine first develop?

My father died of renal cancer when I was eleven. We were poor, lived in rural Arkansas, and had very limited access to health care. Even though I didn't know what it would entail, I set my sights on becoming a doctor or a scientist who studies cancer, hoping someday to spare another child from having to watch his father die. That was a big dream for an eleven-year-old boy, but that's how it all started for me.

And that youthful dream continued to inspire you throughout school?

Yes. By high school, it was clear that I had a strong affinity for science. In biology class, my mind was always racing ahead, wondering "What are the implications of this? How did they discover that? How do they know this is true?" I loved biology.

For me, though, as I looked ahead, personal considerations were more important than academic ones. I had to become comfortable with the idea that I *could* be a doctor or scientist. Growing up in rural Arkansas, I had never seen a scientist, let alone an African American scientist. Lack of exposure to role models is, I think, a major impediment to minority students' becoming interested in science as a career—it's simply not a lifestyle they're familiar with. One of the great joys of my work now is talking to young people, trying to convey my excitement and enthusiasm about my life as a scientist.

How did you address your own lack of exposure to the world of science?

I read every book I could find about science and scientists, to learn not just about science itself but also about becoming a scientist. If you know what the process is, know the road—where the curves and forks are—you can prepare yourself and take it one step at a time.

To be honest, though, some people were very discouraging about the prospects of someone in my situation becoming a doctor, let alone a scientist. But there were others—my mother and my biology teacher, in particular—who always encouraged me, who never let me take no for an answer. They provided the emotional support I needed to make it to the next step.

And that next step was a big one: Harvard.

Coming from a small town and a high school of 800 students to that unbelievably incredible place was quite something. The intellectual caliber there is so high. I was valedictorian of my high school graduating class, but many of my fellow students at Harvard had done far more exceptional things.

I had a very humbling experience my first year there. Thinking it would give me a nice jump on my premedical education, I took an advanced course in physiology—and I got a D on the first exam. After a lifetime of As, a D was quite a shock. "What have I done? I've made a tremendous mistake. How could I possibly have believed that I could be successful here?" I have to credit my mother for helping me put things into perspective. Eventually, I saw that the problem was that I had taken an inappropriate course, not that I shouldn't be at Harvard.

Once I got my feet on the ground, I found the opportunities for personal growth and enrichment just amazing. You come away from Harvard feeling that there's nothing you can't accomplish if you approach it the right way. It was a very empowering four years for me.

Your next step was an unusual one for someone headed for a biomedical career. Why did you pursue a Rhodes scholarship?

As an undergraduate, one of my dreams was to become a doctor, then return to Arkansas and set up a health care center in a medically under-served part of the state. A friend suggested that a Rhodes would help me achieve that goal. Many Rhodes scholars go on to careers in public service or politics, so being a Rhodes scholar would not only be enjoyable and rewarding, but would also enable me to meet people who might be helpful when I was ready to set up that center.

The Rhodes is typically a two-year program in which you complete a master's degree in the field of your choice. However, because I was by that time planning to obtain both an M.D. and a Ph.D., I arranged to spend a third year at Oxford so I could complete a Ph.D. there. I studied with a gifted and inspiring immunologist, then returned to the States and came to Johns Hopkins for medical school.

Did you choose immunology because of your interest in cancer?

Yes. For decades, cancer researchers have believed that if we could just get the immune system's attention and direct it to cancer cells, we could change the

progression of the disease. That now appears to be true, although the molecular tools to pursue that strategy were not available when I was a graduate student in the early '80s.

As I studied the immune system, it became fascinating to me in its own right, not just as a means to help fight disease. I'm biased, of course, but I think the immune system is the most interesting system in the body—so marvelously efficient and potent, with so many levels of regulation. It's amazing.

What have you focused on?

My interest is in molecules that facilitate contact between cells called lymphocytes. The immune system is the only system in the body whose cells are predominantly free-floating, dispersed, and physically unconnected to one another. Cell-cell communication is thus essential to the functioning of the system. Some of the communication is accomplished by soluble molecules that diffuse from cell to cell, but much of it occurs when immune cells come into direct contact with one another. The cell adhesion molecules I study are an essential part of that latter process. Whenever immune cells interact, there always seem to be at least five or six different molecules involved, so teasing out exactly what each one does can be quite challenging.

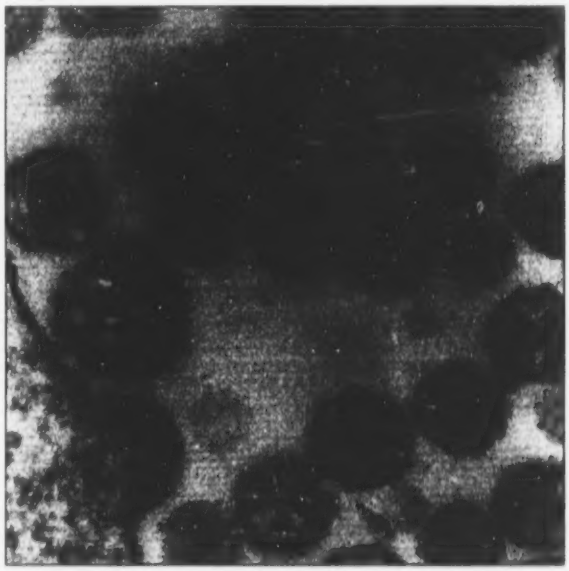
While you were in medical school, AIDS emerged as a serious problem, changing the biomedical landscape. How did AIDS change your research?

When I first became a faculty member in 1987, I felt a little uncomfortable jumping into a field that already had some pretty heavy hitters in it. But I decided to see whether the molecules I was studying might have something to do with the biology of HIV infection. And it turns out that they do.

For some time now, it's been known that HIV binds to cells in the immune system via a particular cell surface protein called CD4. What makes HIV so pernicious is that the subset of immune cells that expresses CD4, called helper T lymphocytes, are sort of the quarterbacks of the immune system. They direct the activity of all the other cells in the system. So if you eliminate helper T cells, as AIDS does, you cripple the immune system.

HIV uses the T cells' own identification markers against them?

Yes. HIV contains only nine genes, but by a stroke of evolutionary bad luck, one of those genes codes for a protein that binds to helper T cells' self-identification protein. Because of that, HIV makes a beeline for the very cells the immune system most needs to fight off viral infections.



Budding Virus: *In the final stage of viral replication, a nascent HIV virus buds from its host cell (lower left). Electron micrograph courtesy of the Laboratory for Infectious Diseases, Hvidovre Hospital, Denmark.*

All of CD4's normal activities require the cooperation of other proteins, including the adhesion molecules I study. So I thought, "If adhesion molecules are involved when immune cells bind to one other via CD4, maybe they're also involved when HIV binds to CD4." And they are.

How? Does HIV produce a protein that binds to the adhesion molecules, too?

No, it uses a more devious method: it steals cell surface proteins from the cells where it replicates. As a virus particle buds off from a cell, it takes part of the cell membrane with it. Since HIV preferentially infects cells in the immune system, the molecules it absconds with include ones involved in immune cell-cell interactions. These stolen molecules enable HIV to bind to any cell that a T cell can normally bind to.

By blocking cell adhesion molecules, however, we've been able to block HIV infection of T cells—at least, in tissue culture. We hope that understanding this process of viral acquisition of cell surface proteins will enable us to come up with new drugs to treat HIV infection.

Would the treatment you're exploring work the same way as the drugs already in use to treat HIV?

No, it wouldn't. The drugs now in use target the virus's ability to reproduce itself—something that it does only after it has already infected a cell. Our approach targets the virus's ability to latch onto and enter a cell—an intervention that might prevent HIV from infecting a cell in the first place.

In a sense, everything in biology comes down to molecules interacting with other molecules, and the consequences of those interactions. When you know something about a biological interaction, you can look for ways to alter or disrupt it. We'd like to be able to disrupt HIV's life cycle in as many different ways as possible. I am studying one line of attack; other labs are busy exploring others.

The AIDS research community is a busy one.

Yes, and a very competitive one. No matter what you decide to study, you will find many, many other laboratories working on the same thing. There are still some areas of immunology where you can carve out a little niche for yourself and be one of only a few scientists working on a problem, but that's not true of anything in AIDS research.

However, if there is any silver lining to this tragic disease, it's that it has drawn so many talented researchers to immunology and virology. Even when we've been unsuccessful in our efforts to thwart HIV, we've learned a great deal. AIDS research has led to many important discoveries, including some very fundamental ones about the immune system and molecular biology. Progress in these areas has moved ahead more quickly than it would have had we not been racing to understand this complex virus.

Do you use both your graduate and your medical training in your work? What have

you found to be the value of having an M.D./Ph.D.?

My daily life is more like that of a Ph.D. than an M.D.; I work in a lab, not a clinic. But even though I don't actually see patients, my medical training affects the context in which I think about research problems. Knowing about the things that can and do go wrong in the human body makes it easier to sense when a new finding might have clinical implications. And while I work at the molecular level, I always like to keep an organismal or whole-person perspective in mind. I think that having training in medicine as well as basic science encourages you to see the patient as well as the underlying biological puzzle.

What do you see happening in immunology's future?

Many of the fundamental questions about how the immune system works have clearly been answered in a general way, although we are certainly busy trying to fill in the outline. And there always seems to be yet another discovery that represents a breakthrough in our understanding of this complex system.

But there are also many unanswered questions, especially about modulation of the immune system. Even something as essential to our existence as reproduction holds immunological mysteries: we still don't fully understand why a pregnant woman's immune system doesn't reject the fetus, which is, after all, an immunologically foreign body.

Some other big questions have barely been touched. It's now quite clear, for instance, that the immune system is influenced in very profound ways by other systems in the body, especially the nervous system. How these two complex systems relate and how those interrelationships are controlled remains largely uncharted territory. (I always tell my students that everything in biology is connected to everything else—we just don't understand all the connections yet.)

One of the things I find attractive about immunology as a field is that it can accommodate so many kinds of biological curiosity—from the very basic to the very applied, from the genetic to the structural. The immune system can be meaningfully explored at many levels.

These are basic biological matters. Immunologists will also have important roles to play in applied biology, developing new medical technologies such as gene therapy and xenotransplantation.

One of the things I find attractive about immunology as a field is that it can accommodate so many kinds of biological curiosity—from the very basic to the very applied, from the genetic to the structural. The immune system can be meaningfully explored at many levels.

Do you have any final words of advice?

Well, I guess I would say that it's a long road from where your readers are now to where I am, and it's important to take advantage of what life offers you at each step along the way. I encourage students to develop a range of interests—not just preprofessional ones—while they have the time and opportunity. We all need outside interests for relaxation, to recharge our batteries, and to turn to in hard times. There is a wholeness to life—family and friends, what we do to earn a living, what we do to enjoy ourselves—and all aspects are important in shaping us and preparing us for what is a lifelong journey of discovery.

If I had it to do over, the one thing I might do differently would be to spend my Rhodes scholarship studying literature. I'm a great fan of Shakespeare, and I gave serious thought to that tempting possibility—what could be better than to study Shakespeare at Oxford? At the time, two years seemed like too much time to give to a non-career-related interest. Now I realize that taking two years out would not have made much difference to my career in the long run. And now that I'm fully engaged in my career, I'll never again have two years to do something like that.

But I really have nothing to complain about. I am tremendously fortunate to have been able to realize my childhood dream. Not many folks can say they are doing what they always wanted to do. What a blessing it is to be able to say that. ■

Selected Resources

Clark, W.R. *At War Within: The Double-Edged Sword of Immunity*. New York: Oxford University Press, 1995.

Cohen, J. "The New Face of AIDS." *Science* 28 June 1996: 1876–1890.

Gorman, C. "Man of the Year: Dr. David Ho, AIDS Researcher." *Time* 30 Dec. 1996: 52–73.

Hall, S.S. *A Commotion in the Blood: Life, Death, and the Immune System*. New York: Henry Holt, 1997.

Nowak, M.A., and A.J. McMichael. "How AIDS Defeats the Immune System." *Scientific American* Aug. 1995: 58–65.

Piel, J., ed. "Life, Death, and the Immune System." (special issue) *Scientific American* Sept. 1993: 52–144.

Related Web Sites

All the Virology on the WWW:
www.tulane.edu/~dmsander/garryfavweb.html

HIV Replication:
www.micro.msb.le.ac.uk/335/335Replication.html

AIDS Pathology:
medstat.med.utah.edu/WebPath/TUTORIAL/AIDS/AIDS.html

For additional related Web sites, see
jhunix.hcf.jhu.edu/~setmentr/links_55.html

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THE 57TH ANNUAL SCIENCE TALENT SEARCH

Every March the finalists in the nation's most prestigious precollege science competition are invited to Washington, D.C., to be honored for their accomplishments. For two days, the 40 Science Talent Search (STS) finalists exhibit their work to the public, allowing science enthusiasts to talk with young investigators about their projects, passions, and perspectives.

Scan the titles of the STS finalists' projects and you'll sense the range of topics that inspire young scientists. Some are fascinated by the lure of the unknown; others, by a desire to find practical applications of knowledge. This year's top two winners exemplify these two sorts of curiosity.

First-place winner **Christopher Mihelich** studied the behavioral peculiarities of sets of polynomials called quotient rings. Nobel laureate Dudley Herschbach, speaking to *The Washington Post*, likened Chris's work to "stringing together DNA molecules, then studying what kind of critter emerges. It is a subtle kind of a mathematics and quite extraordinary for a high school kid to be doing."

Why was Chris interested in these mathematical exotica? "Such quotient rings have connections to string theory," Chris observes, "but I haven't studied enough physics to understand those applications. I just found the problem an enjoyable challenge. One pleasurable aspect of mathematics is the sense of exploring territory that is at once familiar and unfamiliar. Sometimes as one reads a proof, one feels as if on a wild goose chase, following paths that are going nowhere. Then suddenly the last step makes everything fall into place, and one feels surprised, delighted, and perhaps as mystified as ever."

STS finalist Michael Lee talks to visitors.

Mystified by more pragmatic matters, second-place winner **Ravi Shah** focused on a problem with immediate implications: the means by which some tumor cells elude treatments intended to destroy them. "Even after surgery, radiation, and chemotherapy, some malignant glioma cells survive to launch a second, fatal attack on the patient," Ravi explained. How? In part by activating self-correcting mechanisms built into healthy cells. "Normally, it's advantageous for a cell to have enzymes that find and correct damage to its DNA. But when that damage is intentional—as it is in the case of radiation and chemotherapy—those repair enzymes reduce the effectiveness of the treatment. We wanted to better understand how glioma cells achieve their resistance to such therapies."

Working at the Barrow Neurological Research Institute in Tempe, AZ., Ravi showed that a specific DNA repair system may mend chemotherapy-induced DNA damage, thereby enabling glioma cells to escape destruction. "We are now beginning to test whether chemotherapy is more effective when this DNA repair pathway is inhibited. It's incredibly exciting to know that my research may have a real impact on cancer treatment."

Whether they venture into abstract or applied realms, the STS finalists show just how far curious—and dedicated and resourceful—young investigators can go. ■

This Year's Top Honorees

In addition to public recognition, STS finalists win scholarships. First-, second-, and third-place winners receive $40,000, $30,000, and $20,000, respectively. Fourth- through sixth-place winners receive $15,000. Seventh- through tenth-place winners receive $10,000. The remaining 30 finalists each receive $1,000 scholarships.

This year's top winners and their projects were:

1. **Christopher Mihelich**, 16, of Carmel, IN. *Structure of a Polynomial Quotient Ring Involving Symmetric Polynomials.*

2. **Ravi Shah**, 17, of Tempe, AZ. *Nucleotide Excision DNA Repair: Novel Implications in Therapy Resistance in Human Malignant Gliomas.*

3. **Parker Conrad**, 17, of New York, NY. *Changes in Functional Receptors on the Post-Synaptic Neuron During the Maturation of an Identified Synapse.*

4. **Sohini Ramachandran**, 15, of Fair Oaks, CA. Homo sapiens *and* Arabidopsis thaliana: *Mathematical and Computer Intensive Studies of Geographic Molecular Variation.*

5. **Travis Schedler**, 17, of Carbondale, IL. *Construction and Properties of Set-Theoretical Solutions to the Quantum Yang-Baxter Equation.*

6. **William Greenleaf**, 18, of Rochester, MN. *Artificial Cavitation Nuclei Significantly Enhance Acoustically Induced Transfection.*

7. **Ann Kromsky**, 17, of Corona, CA. *Computational Model of Child Memory: Memory Acquisition Without Biological Constraints.*

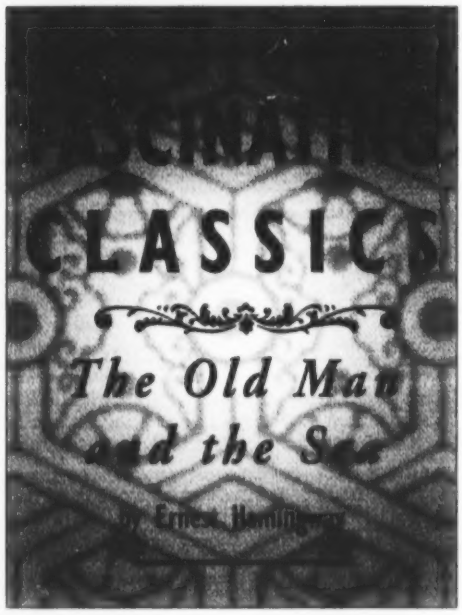
8. **Jonathan Kelner**, 17, of Old Westbury, NY. *Universality of the Near-Zero Microscopic Eigenvalue Spectrum of Random Matrix Ensembles of Infinite Variance.*

9. **Patrick Goodwill**, 17, of Plano, TX. *Development of a Novel Silicon/Diamond Sensor for Trace Metallic Contaminant Detection in Wafer Processing Chemicals.*

10. **Jesse Anttila-Hughes**, 17, of Bronx, NY. *Computer Model of the Transmission of an Action Potential at the Neuro-Muscular Synapse in a Myasthenia Gravis Patient.*

For more about the STS and all the finalists' projects, see www.sciserv.org/weststs.htm

Review by
Lesley Mackay & Charles Beckman



Charles: *The Old Man and the Sea* is a great book to discuss because it's quick and accessible. You can read it in just a few hours. Hemingway's two significant characters (not counting fish)—the old man and his former fishing partner, the boy Manolin—meet at the fisherman's shack at the beginning of the novel and reunite there at the end. The heart of the narrative shows the determined old man sailing out into deep seas, where he gives himself entirely to a three-day battle with a huge marlin.

Lesley: The old man, whom Hemingway occasionally refers to by the name of Santiago, used to fish with Manolin. However, he has become so stigmatized in his fishing village by a run of bad luck—84 days without a fish—that Manolin's parents have insisted that their son go out with other fishermen. So Manolin appears in the morning to awaken Santiago, to cheer him, to make sure he has coffee, and to accompany him out to his boat, but Santiago sails alone. The narrative follows the old man's superhuman attempt to reverse his misfortune, to redeem himself by catching a great fish.

Charles: The action unfolds in the waters off Cuba, a setting so stripped down that it barely registers. I think that in this story Hemingway relies very little on traditional devices of fiction like setting, plot, and character.

Lesley: Hemingway's narrative elements can seem pared down and minimalistic. But I think they seem so because they have been inflated so much that they are massive and, at times, hard to see. The book's oceanic setting is perhaps the clearest example of Hemingway's use of outsize story parts. His hypnotic descriptions of the Gulf Stream waters emphasize the sea's power and, by contrast, point to the fragility of man:

> *The water was a dark blue now, so dark that it was almost purple. As he looked down into it he saw the red sifting of the plankton in the dark water and the strange light the sun made now. He watched his lines to see them go straight down out of sight into the water and he was happy to see so much plankton because it meant fish. The strange light the sun made in the water, now that the sun was higher, meant good weather and so did the shape of the clouds over the land. But the bird was almost out of sight now and nothing showed on the surface of the water but some patches of yellow, sun-bleached Sargasso weed and the purple, formalized, iridescent, gelatinous bladder of a Portuguese man-of-war floating close beside the boat.*

The appearance of the word "now" in almost every sentence enhances the lulling effect of this passage, which reads like a series of lapping waves. It also emphasizes that, as the fisherman gets closer to the biggest fish he has ever hooked, he moves into the heart of the present.

Charles: I agree, Lesley, that Hemingway's minimalistic narrative creates a sense of vastness and universality. His elderly fisherman, Santiago, is an epic character like the warriors and kings of classic literature. The old man's vulnerability arouses our compassion, but from the very beginning of the novel, Hemingway hints at his heroic nature:

> *The old man was thin and gaunt with deep wrinkles in the back of his neck. The brown blotches of the benevolent skin cancer the sun brings from its reflection on the tropic sea were on his cheeks. The blotches ran well down the sides of his face and his hands had the deep-creased scars from handling heavy fish on the cords. But none of these scars were fresh. They were as old as erosions in a fishless desert.*
>
> *Everything about him was old except his eyes and they were the same color as the sea and were cheerful and undefeated.*

Lesley: I, too, love that passage, with both its great physical description of a person who is old and its hints of enduring vitality. The passage prepares us for the novel's major confrontation in which the old man takes part in a battle so great that it forces up all the paradoxes of his nature: He finds that he is both aging and ageless, frail and powerful, insecure and confident, humane and destructive, vanquished and triumphant.

Charles: It's interesting to speculate how autobiographical Hemingway's portrait of the fisherman was. The author loved Cuba and the water, and both in life and in his fiction, he returned again and again to scenes in which men struggle for survival and conquest (for example, he was devoted to attending bullfights in Pamplona, Spain, which he wrote about in his novel *The Sun Also Rises*). Furthermore, Hemingway both felt and was interested in the deep tensions within human nature. For example, sketching the characters of men with strong, silent, masculine demeanors, he often shaded sensitive, troubled personalities underneath. As you point out, in Hemingway's portrait of the fisherman, the contradictions become so

Images of Redemption in *The Old Man and the Sea*

Ernest Hemingway was born in the Midwest in 1898. At 18 he became a volunteer World War I ambulance driver based in Italy; later, he moved to Paris, joining a group of American drifters, a "lost generation" disconcerted by war and unsure of the future.

In Paris, Hemingway wrote short stories and novels that articulated the modernist sense that human life may ultimately lack meaning. However, while exploring and popularizing a bleak sense of "nothingness," Hemingway also brought to his writing more positive values, adopting a sometimes Romantic appreciation of nature and espousing human qualities such as courage, empathy, and "grace under pressure."

After World War II, Hemingway moved to Cuba with his fourth wife. In 1952, two years before he won the Nobel Prize in Literature, he wrote *The Old Man and the Sea*. Into its patterns of light and dark he wove love of nature, dread of solitude and death, and, perhaps surprisingly, a vivid intensity of experience conveyed in part through ideas and images from Roman Catholicism.

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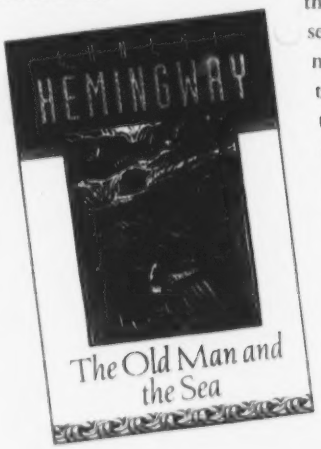
strong that they emerge thematically. I think it's safe to say that this novel is the product of a great deal of introspection.

Lesley: The novel gains its introspective quality in part through Hemingway's narrative technique. He tells *The Old Man and the Sea* in the third person, through a narrator who is not a participant in the action. This narrator is partially omniscient—not merely an observer who records what the fisherman does and says, but one with insight into the fisherman's thoughts and feelings. The narrator knows, for example, that Santiago finds the early morning sun painfully bright, that he believes that killing a great fish is unjust, and that in his dreams he returns to an African beach where lions lie about on the shore, a magnificent scene he remembers from an earlier fishing trip.



The narrator keeps us attuned to Santiago's thoughts and feelings by re-creating them in an interior monologue that, intermingling with the plot, ebbs and flows throughout the book. For example, midway through the narrative, Santiago contemplates the amazing marlin he has hooked as it swims alongside the boat, and muses about whether he will ever pull it in:

> *You are killing me fish, the old man thought. But you have a right to. Never have I seen a greater, or more beautiful, or a calmer or more noble thing than you, brother. Come on and kill me. I do not care who kills who.*

Charles: Santiago's fabulous marlin, like Captain Ahab's great whale, Moby Dick, in Melville's novel, is not so much a fish, but a Fish, an animal as replete in symbolic power as it is in natural strength.

Hemingway foreshadows the old man's encounter with this magnificent creature: sailing out, Santiago observes that it is fall, the season of "the truly big fish" that are hardest to reel in, that can bring the greatest glory. Hours later, he hooks an animal that is more fish than he had ever dreamed of. I think the marlin is the perfect expression of the natural world and of its ultimate indifference to human desires.

Lesley: I agree that the fish represents those things. But I believe that the novel offers a more hopeful vision than the fish suggests.

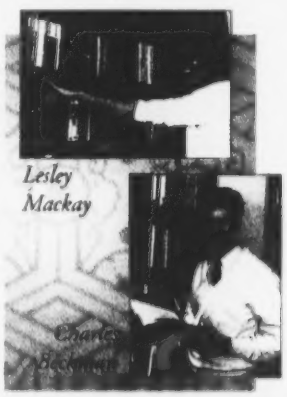
Charles: Really? To me, this novel reflects an uncompromising perspective. I don't want to give away the unexpected resolution of Santiago's struggle with the fish, but I do think that the book suggests that the enormous effort of a human being, in the words of Hemingway's tough-guy contemporary Humphrey Bogart, doesn't amount to a hill of beans.

Lesley: That reading seems stark to me—it fails to account for the important victories won by the protagonist. Santiago is a hero, a man who goes to the limits of his own capacity while facing down the world's indifference. He does this with tremendous grace: instead of regretting his old age, his growing frailty, his long run of bad luck, or his lost reputation, he embraces the perilous and exhausting test that faces him. I think he surpasses the example of his hero, the baseball player Joe DiMaggio, whose strength, craftsmanship, and consistency he praises as he sails out into deep waters.

Hemingway does make it clear that Santiago cannot prevail against all the challenges thrown at him by the ocean. Yet he convinces me of the value of Santiago's attempt to move up the hierarchy of nature by stealing a great fish from the sea. Furthermore, the novel proposes meaningful alternatives to the full victory that Santiago craves: dedication and excellence in one's work; love, even of the terrible beauty of the universe; and human community.

Charles: Community is an important theme in this novel, which offers a rich meditation on the possibilities and problems of solitude. Santiago sails out utterly alone. For just a moment, he imagines how much better it would be to fish with a radio, listening to the baseball games he so loves. But Santiago cannot afford food, let alone a radio, and his poverty both reinforces and represents his alienation from the community. He imagines that this loneliness can never change: "No one should be alone in their old age," he thinks, before adding, "But it is unavoidable."

Lesley: However, in the course of the novel, Santiago's relationship to his community does change. The town searches for him "with coast guard and with planes" when residents realize that he has not returned at night. And when he does return, with remains of the massive marlin on the side of his boat, the community understands that the old man has done well in a monumental battle. Santiago then regains stature and the interest and compassion of others. Best of all, he regains an important partnership when Manolin decides to return to his boat: "We will fish together now for I still have much to learn," the young boy says with kindness and wisdom, in full knowledge of the old man's integrity and greatness. ■



Critics have pointed out that Santiago can be compared to Christ or to saints and martyrs in his intense suffering, his alienation from the world, and his faith in the possibility of redemption. He prepares himself for his meeting with the marlin with fervor, starving himself and meditating prayerfully on the beauty around him. During the course of the novel, he sustains wounds that mirror those of Christ. Through his noble fight with the fish, he attains a kind of resurrection, returning to his village with an inspiring story to tell.

Hemingway was born a Methodist but said that he had been won over to Catholicism when a priest ministered to him after he was wounded in World War I. However, Catholicism was just one of many philosophical and aesthetic sources from which he drew as he gave expression to the meaningful and the meaningless, the possible and the impossible, the bright and the shadowed.

Upcoming Fascinating Classic:

J.R.R. Tolkien, *The Hobbit*.

155

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The College Review Series is intended to aid prospective college students in their search by offering insiders' views of selected colleges and universities, as expressed by current undergraduates or recent graduates who have high academic ability. Note that the number of reviewers is small. Consider their personal perspectives as only one component as you gather information and impressions from many sources.

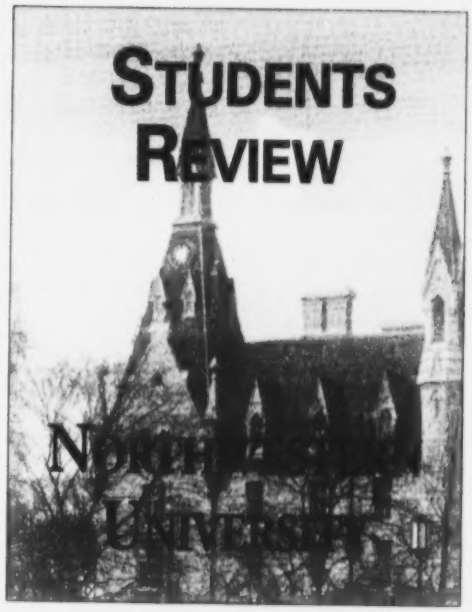
Our reviewers include eighteen students, who major(ed) in American studies (1), biology (1), biomedical engineering (2), communication studies (1), computer science (2), economics (1), geology (1), integrated sciences (2), international studies (1), journalism (1), materials science (1), math (3), mechanical engineering (1), music composition (1), music theory (1), neurobiology (1), physics (1), political science (1), and sociology (2). (The number of majors exceeds eighteen because several students completed double majors.)

Quality of Academic Instruction for Undergraduates

Northwestern University (NU) houses six undergraduate schools: Arts & Sciences, Journalism, Speech, Music, Engineering, and Education & Social Policy. Students may complete degrees in more than one school. NU also offers a number of prestigious special-focus programs including the Integrated Science Program and the Honors Program in Medical Education.

"NU is large enough to attract some of the best research and teaching professors in the country, but small enough to offer students access to this prestigious faculty. With a minimum of effort, you can regularly find stimulating classes taught by fantastic professors who are accessible and genuinely concerned with undergraduates."

"NU offers a number of exceptional special programs. The Integrated Science Program (ISP) is a carefully constructed curriculum emphasizing the common bases and the interrelationships between the physical sciences and mathematics. Taught by some of NU's best science faculty, ISP courses are extremely rigorous and packed with challenging content. The quality of instruction is, with few exceptions, superb. Classes are small—about thirty students in the first year and no more than fifteen in upper-level classes."



"The Honors Program in Medical Education (HPME) is an accelerated, combined B.A./M.D. program—three years for the B.A., then four years of medical school. Knowing that you have a guaranteed place in med school takes a lot of pressure off, especially in 'weed-out' classes like organic chemistry. One drawback is that the accelerated curriculum affords little choice in major courses and no room to take unrelated courses. You must also be sure of your major when you start; there's no time to dabble."

"NU's Medill School of Journalism has the finest undergraduate journalism program in the country. Every class makes you feel like you have a lot to learn—and you do! But professors are always willing to talk, to offer advice on job or internship searches, or to refer you to others who might be helpful. You really feel like you are in a network at Medill, one that includes not only the faculty, administration, and current students, but also thousands of alumni and professionals in the field—all there to provide help and guidance when needed."

"Medill's program requires its students to diversify; two-thirds of our classes must be taken outside the journalism school. This helps us develop the knowledge base we'll need to be good journalists and also allows us to focus on another subject area that interests us."

"The engineering core curriculum offers a lot of flexibility and allows students to have a liberal arts education as well as a technical one. We must complete a coherent, self-selected group of liberal arts courses. You can design your 'theme' (as this requirement is called) around anything that interests you as long as the courses are demonstrably related."

"In addition to excellent arts & sciences, journalism, and engineering programs, NU has an amazing theater program in the School of Speech. Speech is home to several of NU's strongest programs, including communication studies, radio/television/film, theater, and communication sciences & disorders. We also have one of the top music schools in the country. Many music students complete dual degrees with the other schools; it's not uncommon to meet opera/neuroscience or harp/astrophysics double majors."

"As a student in the Music School, I benefit from having the rest of the university to draw upon. I have many more resources available to me than I would at a conservatory. The opportunity to study art history, drama, literature, poetry, or anything else is a big plus."

"I came here as a music and engineering student. While I have since dropped my computer science major, it got me interested in music technology. This sort of cross-pollination is a great feature of NU. I've found many students who have several divergent interests, which makes the campus population well-rounded and interesting."

"An important fact about NU is that it runs on the quarter system, which is much more intense than a semester system. We have three sets of finals per year. With a normal course load being four courses per quarter, this system helps us cram more courses into our college years."

Social Life

NU's social life reflects the interests of the diverse student body, while nearby Chicago supplements the extracurricular options.

"NU's setting on Lake Michigan is absolutely gorgeous. In warm months, students are found rollerblading, playing volleyball, and relaxing on NU's private beach. In addition, Chicago's glorious, inexhaustible resources are just a train ride away. With everything from world-class museums, music, and sports to ethnic neighborhoods and restaurants, Chicago is a gold mine."

"Basically, if you want it, it's there. The El-train into Chicago is cheap and accessible, and greatly expands the social options. Clubs are widespread in Chicago (although not in Evanston). Evanston, a small, lovely town, is not at all a typical college town. It has a very conservative feel, and it closes at 6–7 pm, so 'late night' (after 8 pm!) opportunities are limited."

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"Well, NU is not exactly a party school, although there is definitely fun here if you look for it. The Greek system is huge but not exclusive. Social life is split between two campuses: North Campus has the fraternity quads and the athletic center, so it's very sports- and Greek-oriented, while South Campus is where the more artsy students traditionally live. On weekends, you can definitely find a frat party, but you can probably also see two or three student-produced plays if you want."

"Most students live in dorms their first two years, then off-campus or in Greek housing after that. There are also Residential Colleges (RCs), which provide an important alternative to both dorms and Greek housing. Each RC has an academic theme—science & engineering, public affairs, international studies, performing arts—and sponsors many functions organized around its theme. RCs are exempt from the lottery system that assigns scarce on-campus housing slots to upperclassmen. Instead, housing assignments are based on the number of points an individual accrues for contributing to his or her RC (by organizing an RC-sponsored lecture series, for example). The RC system strives to foster an academic atmosphere in its living units."

"NU's special programs (ISP, HPME, the American Cultures program, and Mathematical Methods in the Social Sciences, to name only a handful) provide close-knit, supportive social communities for program members."

What Do You Like Best about Northwestern?

"The solid career preparation. NU produces really 'together' graduates."

*"The opportunity to pursue **all** my interests. With its six schools, NU makes it easy to pursue diverse interests. A chemical engineering major who plays the piano can take private lessons in the School of Music. A history major who loves to dance can take classes at the School of Speech. At no time does the administration tell students they must make a choice. All doors are open and inviting."*

"ISP. It offered me exceptional career opportunities and the chance to meet many stimulating peers and faculty. Through it, I completed bona fide research projects in chemistry, physics, and mathematics—a feat simply not possible outside of ISP."

What Do You Like Least about Northwestern?

"The weather and the endless winters! As I write this, it's May 28th and maybe 40°F outside—definitely something to consider, since students must walk or bike everywhere. Also, the atmosphere sometimes seems too competitive. It feels like no one takes time to just chill out and relax. It's good that everyone's so motivated, but it can be stressful."

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- 4-year private coed university.
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- Special features. For more about HPME or ISP, see www.nums.nwu.edu/viewbook/idx_eduprog.htm or www.isp.nwu.edu/ respectively.

"The quarter system is incredibly demanding. Three weeks into the quarter, midterms begin, and from then until the end of the semester, hardly a week goes by in which you have no exams to take. Although this can be a plus when you consider how many more courses you will take compared to students at semester-system schools, it's a huge negative in terms of the amount of stress you will be under and the amount of work you will have for the majority of the quarter."

Who Would Be Most Compatible with the Academic and Social Atmosphere at Northwestern?

"NU students tend to be highly motivated, extremely career-oriented, slightly conservative, and Midwestern. There are few trendy dressers or people with unfriendly attitudes."

"Most students here are preprofessional and tend to be more pragmatic than deeply curious. Few want to study a subject for its own sake; there's always an ulterior motive. NU is thus a studious but not a highly intellectual campus. Through the RCs and some of the special programs, however, you can find more intellectually inclined peer groups."

"The students likely to get the most out of NU are those in the special programs, which offer exceptional educational opportunities. Their curricula hold their own when compared to those at any university in the U.S."

If You Had It to Do Over Again, Would You Go to Northwestern?

All but one reviewer (who was unhappy with his major department) were very satisfied with NU.

"Absolutely. NU is a tremendous institution to which I owe much of my current success. My years there were a time of intellectual growth, challenge, stimulation, and frustration that defines me more than any other period of my life. And this serves as a perfect definition of a successful undergraduate experience."

"Definitely. You can find excellent academics elsewhere, but the location—on the shore of Lake Michigan and in the shadow of Chicago—is prime. Having grown up in the East, my horizons have been broadened by living in the Midwest, which has its own distinct flavor. I simply love the warm, understated manner so common here."

"Actually, NU was not my first choice. When I came here, I almost had the attitude that NU had something to prove to me. It has impressed me and gone beyond that—I went from a skeptic to an enthusiastic advocate. I feel that NU has been the right place for me because of the wide range of opportunities it offers. And I loved getting to know Chicago."

As you try to find the college or university best suited to you, the views presented above may be helpful. Keep in mind that these students might have had similar positive or negative experiences had they attended a different school. At any college, it is important to seek out challenging academic experiences and to create a social life that fits your personal style. ■

Note: The students quoted in the College Review Series are expressing their own views, which are not necessarily those of JHU or IAAY.

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PLANNING AHEAD FOR COLLEGE

Visit Colleges This Summer

by Linda E. Brody, Ed.D.

Virtual college visits have become a reality. Videotapes and the Internet bring images of life on campuses around the country into your home. As you scan the net and view the videos, read about colleges in books and catalogs, and talk to college-aged friends and siblings about their experiences, you will have much of the information you need to decide whether a college is right for you. But a personal visit is the only way to get a real feeling for life on a campus.

It's clearly better to visit colleges when classes are in session than in the summer. Although some colleges offer summer sessions, many empty out so that you are left evaluating the campus facilities rather than students' experiences at the college. But since your school work and activities can make it difficult to get away during the school year, it can be useful to make preliminary visits during the summer to a wide variety of colleges. Then, you can return when classes are in session for a second visit to those that really interest you.

Getting the Most out of Summer Visits

Before you visit a college or university, do your homework. Learn about the school and think about concerns you have about that college. Identify questions you want to ask.

Call the admissions office in advance to find out about scheduled tours and group information sessions. Tours are usually led by students who are very knowledgeable about the facilities as well as about student life on campus. Don't hesitate to ask questions as you tour the campus. Group information sessions are also valuable for learning about the college. Often led by a member of the admissions office staff, these sessions can give you insight into the way admissions and financial aid decisions are made at that college or university.

As you walk around each campus, take in the atmosphere. Also visit the surrounding community. How comfortable do you feel? What characteristics of the college environment contribute to your comfort or lack of comfort? Begin to answer such questions as: Do you prefer a college in an urban or rural area? Do you like a small or large campus? Does the presence of on-campus security make you feel secure or nervous? Do you prefer a particular type of housing? If something affects you in a negative way, evaluate that aspect carefully in the next college you visit.

It's fun to build a summer vacation around college visits. Depending on the college's location, you can enjoy the ambiance of a small town or an urban center as part of your visit and plan activities accordingly. Many colleges have historic buildings and museums on campus, and there may be historic sites nearby. Visit the college bookstore. Explore local shops. Eat in an outdoor café. Investigate local tourist attractions. A tour of colleges can be an excuse to visit a part of the country that you've never seen and can provide for a wonderful vacation for the whole family.

If your summer plans are already made, consider including some college visits in your plans. Even if your first-choice colleges are not located where you will be traveling, visits to any college can help you define aspects of campus life that are important to you.

Because it's summer, you might be tempted to dress very casually for your campus visits, and you will see other prospective students in shorts, t-shirts, and tennis shoes. Nonetheless, it's advisable to dress more appropriately. You want to give the impression that this visit is important to you and that you care what the people you meet think about you.

Interviews

Even if you haven't applied to the college you're visiting, you can arrange to have a personal interview with a member of the admissions office while you're on campus. It's another way to get information about a college, and it is often easier to get an appointment in the summer than during the school year.

Colleges vary in whether they require personal interviews and to what extent interviews affect admissions decisions. Some offer interviews conducted by alumni in your local community. In general, the trend is to offer interviews to help answer students' questions but not to weigh them heavily in the admissions process. An interview may be required and more important for certain applicants such as Early Decision candidates or young applicants.

Return Visits when Classes are in Session

Most campuses look quite different during the school year than in the summer. Students rushing to class, meeting in groups on campus, and hanging out in cafés will make the atmosphere seem much more alive. Once you've narrowed your college choices, a more in-depth look during the school year is important. You should probably stay two days, including an overnight stay in a dorm.

Talk to students. Attend classes. Hang out where students hang out. See what they do in their free time. Schedule appointments with faculty members in your areas of interest. Meet with people who work in activities in which you hope to become involved, such as coaches, newspaper editors, or orchestra leaders.

Visiting colleges requires a serious time commitment. But by scheduling your initial visits during the summer, you can reduce the number of visits you need to make after school begins. ■

If you're planning for college ...

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THE COACH'S CORNER

by Chengde Feng

***Mr. Feng** teaches mathematics at the Oklahoma School of Science and Mathematics (OSSM) and has coached many students who have competed successfully in mathematics contests in China and the U.S. In this column, Mr. Feng offers Imagine readers questions designed to improve their problem-solving skills.*

PROBLEMS

1. Let m, n, p, and q be nonnegative integers such that $\frac{(x+1)^m}{x^n} - 1 = \frac{(x+1)^p}{x^q}$ for all $x > 0$. Find $(m^2 + 2n + p)^{2q}$.

2. Given that $a > 0$, $b > 0$, and $a^3 + b^3 = 2$, find the maximum value of $a + b$.

3. Given that the two distinct positive roots of the equation $ax^2 + bx + 1 = 0$ are both less than 1, where a and b are integers, find the smallest possible value of a.

SOLUTIONS

1. Substituting $x = 1$: $2^m - 1 = 2^p \Rightarrow m = 1, p = 0$

$\Rightarrow \frac{x+1}{x^m} - 1 = \frac{1}{x^n}$ for all $x > 0 \Rightarrow x^n[(x+1-x^m) = x^n$ for all $x > 0$

Substituting $x = 2$: $2^n(3 - 2^m) = 2^m \Rightarrow n = 1$, $q = 1$ (why?) $\Rightarrow (m^2 + 2n + p)^{2q} = 3^2 = 9$

2. Alternative 1: If $a = b$, then $a = b = 1$, and $a + b = 2$. (1)

If $a \neq b$, let $a > b > 0$, since $a^3 + b^3 = 2 \Leftrightarrow 1 - b^3 = a^3 - 1$

$\Leftrightarrow (1-b)(b^2 + b + 1) = (a-1)(a^2 + a + 1)$

then $\frac{a-1}{1-b} = \frac{b^2+b+1}{a^2+a+1} < 1$ or $a - 1 < 1 - b$ (is $1 - b > 0$?) or $a + b < 2$. (2)

(1) (2) $\Rightarrow$ The maximum value of $a + b$ is 2.

Alternative 2: By the A.M.–G.M. inequality, $a^2 + b^2 \geq 2ab$

$\Rightarrow (a+b)^2 \geq 4ab$ or $ab \leq (a+b)^2/4 \Rightarrow (a+b)^3 = a^3 + b^3 + 3ab(a+b) \leq 2 + 3(a+b)^3/4$

$\Rightarrow (a+b)^3/4 \leq 2 \Rightarrow a + b \leq 2$, and $a + b = 2$ if and only if $a = b = 1$.

3. Let x_1 and x_2 be the two roots with $0 < x_1 < x_2 < 1$.

$\Rightarrow x_1x_2 = \frac{1}{a} > 0$, $x_1 + x_2 = -\frac{b}{a} > 0$, and $b^2 - 4a > 0 \Rightarrow a > 0$, $b < 0$, and $b < -2\sqrt{a}$ (1)

$0 < x^2 < 1 \Rightarrow 0 < \frac{-b + \sqrt{b^2 - 4a}}{2a} < 1 \Rightarrow 0 < -b + \sqrt{b^2 - 4a} < 2a \Rightarrow b < \sqrt{b^2 - 4a} < 2a + b$

$\Rightarrow b^2 - 4a < 4a^2 + 4ab + b^2 \Rightarrow -4a - 4a^2 < 4ab \Rightarrow -(1 + a) < b \Rightarrow b \geq -a$ (2)

(1) (2) $\Rightarrow -a \leq b < -2\sqrt{a} \Rightarrow -a < -2\sqrt{a} \Rightarrow a > 2\sqrt{a} \Rightarrow a > 4 \Rightarrow a \geq 5$.

When $a = 5$ and $b = -5$, $5x^2 - 5x + 1 = 0$ has two distinct positive roots that are both less than 1.

Therefore the smallest possible value of a is 5.

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Amanda Brainerd and Janine D'Adamo are students of Lee Ostrov at Friends School in Baltimore. Next fall, Amanda will attend Carnegie Mellon University and Janine will attend the Pratt Institute.

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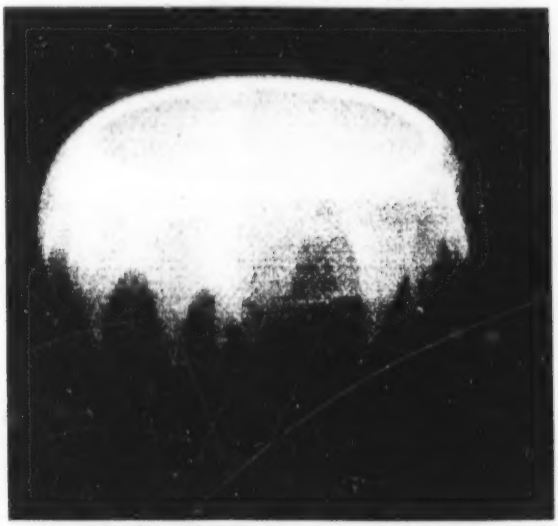

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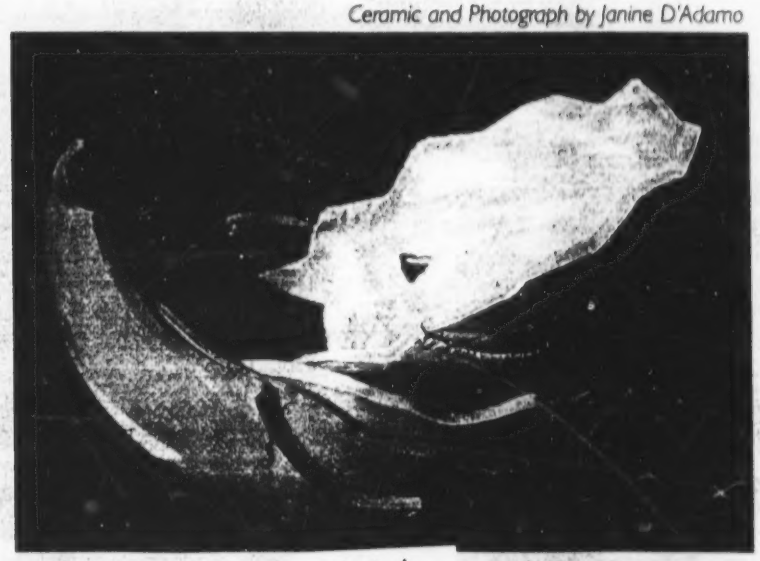


161

Knossos Games

by Tim Boester

*After completing his undergraduate studies at the University of Chicago this spring, **Tim Boester** will continue his mathematical pursuits next year as a graduate student at the University of Wisconsin.*

Congratulations, *Imagine*, on finishing your 5th year.

The Goal:

Go from **Start** to **Finish** by jumping the number of squares designated within each square on which you **land**.

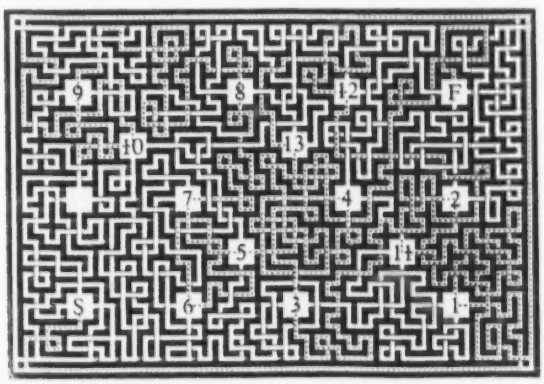
The Rules:

Each move must travel a straight line horizontally or vertically, not diagonally. Use only the numbers in the squares that you **land on**.

								S→ 3	2	3	1	6	3
2	1	4	6	2	2	2	2	6	2	1	2	2	2
1	7	1	8	1	1	1	1	4	3	5	5	3	4
2	1	5	5	5	5	5	5	5	5	5	5	2	3
2	3	5	5	5	5	5	5	5	5	5	5	6	3
4	3	5	5	5	5	5	5	5	5	5	5	7	6
3	2	6	4	4	5	5	5	5	5	5	5	4	6
F	2	1	6	2	5	5	5	5	5	5	5	1	4
			2	1	5	5	5	5	5	5	1	2	4
			3	6	5	5	5	5	5	6	7	8	2
			8	3	2	3	5	5	5	1	2	7	
			4	1	3	4	5	5	4	2	1		
					1	2	1	1	2	1	2		
					2	1	2	2	1	2			

Solution to Knossos Games in our March April issue:

The numbers show the order in which the rooms are visited in the solution path.



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